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ABSTRACT

This technical report describes an in-depth study of the implementation of computers in a comprehensive school which had recently purchased 17 microcomputers. The study investigated the different factors that influenced the introduction of computers into the school at the teacher's level, the departmental level, and the school level. Analyses of data from interviews and questionnaires indicated that the actual implementation of computers was very much dependent upon the interplay of these various factors at the different levels. Although the responses of teachers from five departments--science, history, mathematics, geography, and business studies--covered a broad spectrum of views and opinions, barriers to computer use were generally seen to be lack of time for proper training, inadequate financial resources, and large classes. Favorable attitudes of department heads and appropriate leadership strategies were found to be essential in providing guidance to teachers. The provision of adequate technical and financial resources and expertise were seen to be the function of the school administration, and a rethinking of curriculum and how computer use could be integrated into various subjects were seen to be concerns at the national level. Suggestions for further research and 82 references are provided, and the table of contents of the Ph.D. dissertation is appended. (DJR)

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THE IMPLEMENTATION OF COMPUTERS IN A SECONDARY SCHOOL :

A Case Study of Teachers' Perceptions about Computers in Teaching within the Social Organisation of a Comprehensive School.

(A Condensed Report)

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ABSTRACT

This technical report is a condensed version of a 380-page research thesis conducted in fulfillment of a PhD qualification based at the Centre for Educational Studies, King's College London (KQC), University of London. The research itself consisted of an in-depth study of the implementation of computers in a comprehensive school which had recently purchased seventeen microcomputers. The research looked at the different factors which influenced the introduction of computers into the school. These factors were analysed at three different levels - that of the teacher, the department and the school. At the level of the teacher, teachers' experiences and views of computers and the use of computers in teaching were analysed; at the level of the department, heads of departments' policies in relation to the purchase and use of computers and teachers' reactions to such policies were studied; and at the level of the school, the distribution of resources and facilities were examined. The research study was conducted in three major stages, with semi-structured interviews and questionnaires as the main data-collection instruments used. Lundgren's Frame Factor Theory (1972), White and Lippitt's (1968) leadership categories, and Lewin's Force Field representations (1952), provided frameworks to organise and describe data in the interviews.

It could be seen that the actual uptake of computers is very much dependent upon the interplay of various factors at different levels. The views and opinions held by teachers about computers were not just black or white, but revealed an extremely broad spectrum of views, even within just five departments of a school. Teachers perceived that the use of computers in teaching would result in changes in themselves as an authority, changes in themselves being in authority, and changes in their teaching situation. Organisational constraints were seen as barriers to teachers, which many of them felt could not be solved by themselves but which needed the cooperation from staff "above" them. Some of the main organisational constraints perceived by teachers included those of insufficient time, lack of finance and resources, and the limitation of having big class sizes. All three different leadership styles of autocratic, democratic and laissez-faire were found in the five departments. It seemed that the majority of these teachers initially needed strong guidance before they would venture using computers in their teaching. Leadership styles and strategies which provided resources, training and time, were important before any uptake of computers could occur.

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1.0 INTRODUCTION

1.1 National Initiatives

About two years before this research study commenced, the United Kingdom government introduced two parallel projects for schools which was announced in March 1980 - the Microelectronics Education Programme (MEP) for England, Wales and Northern Ireland, with a budget of about £12 million; and the Scottish Microelectronics Development Programme (SMDP), with a budget of about £1.3 million. Each of the two Programmes were concerned with the whole school cycle of compulsory full-time education for children aged 5-16 years, and with non-vocational college courses for students aged 16-19 years. The Programmes were set up largely as autonomous activities with their own Directors.

The aim of the MEP (Fothergill, 1981) was stated as being "to help schools to prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive". Two broad areas that were looked at by the MEP (Fothergill & Anderson, 1981) was firstly, to investigate the most appropriate ways of using the computer in different areas of the curriculum, whether for the individual child, for small groups of children, or as a system which involves the whole class. Secondly, it aimed to introduce new topics in the curriculum, either as separate disciplines or as new elements of existing subjects. Within this framework, the MEP aimed to provide central assistance to curriculum development, teacher training, and resource organisation and support. These matters would be dealt with by a coordinated network of 14 regional information centres, each with its own regional director. The Programme, which was initially financed for a period of four years by the Department of Education, was later extended for a further period of two years (ending March 1986).

The aims and strategy of the SMDP were broadly similar to the MEP although its establishment dated further back to that of the MEP. SMDP was launched in 1979 by the Scottish Education Department with the aim of being a "pump-priming agency stimulating developments in a selected group of projects based in schools and colleges" (Walker & Megarry, 1981) starting with an initial budget of only £320,000. This was referred to as Phase 1 of SMDP, and a national hardware and software centre was

established. Phase 2 was officially announced in April 1980 with a budget of £1 million over a period of four years. The emphasis of Phase 2 was on the continual development of educational software, and a software library was set up and links made with the MEP.

In addition to these two major Programmes, the Department of Trade and Industry (DTI) decided to provide an impetus to these Programmes by launching a scheme (at a cost of £7 million) to enable all schools to purchase, at half-price, a computer system based on the Research Machines Ltd. (RML) 380Z and the BBC Acorn microcomputers. This was launched in 1981 with the aim of encouraging the purchase of a microcomputer system for every secondary school by the end of 1982. This scheme was subsequently extended to include primary schools with the similar aim of putting a microcomputer system in every primary school by the end of 1984. This scheme was again later extended to include the purchase of certain peripherals, a monitor and printer each. A condition of the school receiving this assistance was that the school had to send two of its staff to an approved In-Service Training (INSET) introductory course on computer awareness.

Other contributing agencies which provided an additional impetus to this national drive included the British Broadcasting Corporation (BBC) which launched a series of television and radio programmes (the Computer Literacy Project being the initial television boost) aimed to provide a general appreciation of computers and computer technology in different areas of life and society; and the National Extension College and the Open University which produced distance/open learning packages on computer awareness. In hindsight, not only did the BBC television and radio programmes provided an awareness to school children, but was also highly instrumental in raising the general public's awareness of computers and information technology. This had a direct effect on the schools, as parents of school children (and teachers themselves) were influenced and this in-turn encouraged them to support the purchase of computers in their childrens' schools or their own schools.

At the time of the concluding stages of this research study, the MEP funding had ended and the government had decided (with much criticism from MEP itself) to provide only a support unit, initially called the Microelectronics Support Unit, whose main brief is to provide a supporting role to the work

started by the MEP. Funds would be provided centrally for only five years, with £2.2 million allocated for the first year and unspecified amounts later. The Scottish equivalent was more fortunate with the SMDP receiving continued funding centrally and being incorporated as part of the Scottish Council for Educational Technology.

1.2 The Growth of Computers in Schools

Internationally, there was a "microelectronics revolution" whereby microelectronics technology was becoming more and more sophisticated and powerful (in terms of memory capacity and speed of calculation), with a reduction in the cost and physical size of the microprocessors. The actual growth of computers in British schools came mainly as a result of these government initiatives. This is because although microcomputer prices had dropped, the cost of a basic computer system configuration (computer plus disc drives and monitor) was still in the range of about £1,000 in the early 1980s which, comparatively, was prohibitive for schools who were still finding money for textbooks etc. Surveys carried out by Mathew (1982) of the BBC Educational Broadcasting Services on computers in secondary education, and another by Educational Computing (1984) both confirmed the fact that the majority of the schools they had surveyed only started buying computers when the Department of Trade and Industry's "£1 for £1" offer (i.e. 50% subsidy of hardware costs) was initiated. Together with additional support from Parent-Teacher Associations and through special school-funding activities, schools started to seriously consider the purchase of computers as a viable option. These initiatives have thus led to a relative leap in the purchase of computers in schools since 1981. For example, in 1982, the average number of computers in secondary schools was 3.2 (Mathew, 1982), increasing to 7.4 in 1983 and to 8.5 in 1984 (Educational Computing, 1984), and by 1985 the avearge number of computers in secondary schools was 13.5 microcomputers (Forthergill, 1986) - a percentage increase of over 400% over a period of about 3 years. This is shown in Figure 1.

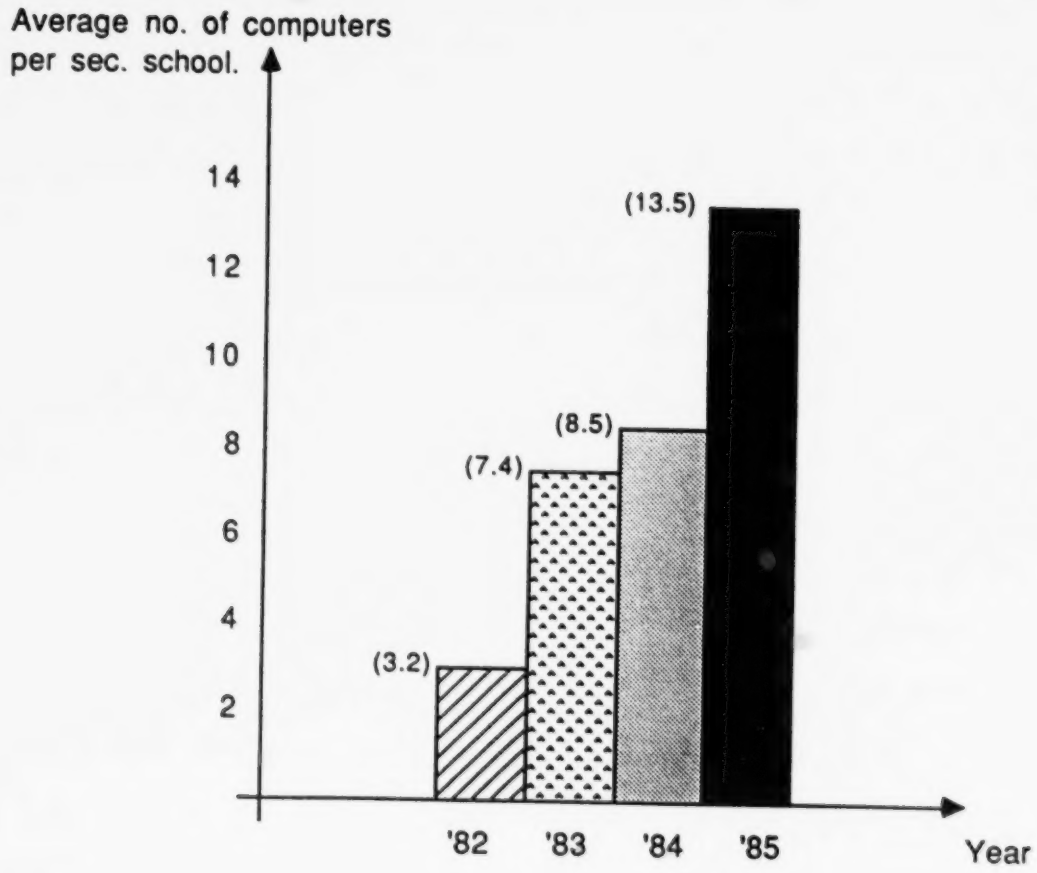

Figure 1 : Average number of computers per secondary school in the UK

What, however, was more important to note was that in all these surveys, those that conducted the surveys began to realise that the emphasis in these schools was primarily in obtaining hardware, while other areas, for example sofware development, training and knowing how to teach with computers, seemed to be a secondary issue.

1.3 Main Issues Not Addressed

When it came to the use of computers in teaching and their applicability in the curriculum, however, there was a growing concern. Atkins (1981) who conducted a survey for the Educational Broadcasting Councils for the United Kingdom in the months of February and March 1981, found that the LEAs' main emphasis at that time was on Computer Studies for the upper secondary school. Mathews'

survey (1982) showed that 94% of the teachers who used computers were in the Mathematics and/or Computing departments, 69% of the teachers who used computers were from one or more of the Science departments, and only 23% of teachers who used computers were in the Humanities (with the Geography department heading the list). Thus, although there was a substantial amount of growth in the number of computers in schools, the worry was that only a certain part of the school curriculum was being exposed to this new educational media.

What was even more of a concern was that when it came to the training of teachers, Atkins (1981) noted that most of the in-service training courses conducted by the local authorities were concerned with Computer Studies (84%). In addition, Mathew found that the majority of members of staff sent on external computer related courses were from the Mathematics, Computing and the Science departments (with Geography coming third, but quite a way behind), and little representation from other departments. Almost all the LEAs (95%) in Atkins study had someone responsible for computers/microtechnology in education, but many of these were or remained Mathematics or Science advisors. Mathew also found that 57% of the secondary schools had appointed a member of staff to be formally responsible for developing the use of computers across the school curriculum. He found, however, that the majority of these members of staff came from the Mathematics, Computing or Science departments. It was not possible to gather from these surveys whether these teachers were given adequate finance, resources and time to discharge these responsibilities. It could be hypothesised that most of these teachers were given these responsibilities in addition to their normal responsibilities (as was the case in Barnaby Comprehensive).

What seemed to be happening was that although there was a dramatic rise in the number of computers in schools, these computers seemed to be concentrated in only the Computer Studies, Mathematics or Science departments, with very few in the Humanities. It would be interesting to discover why these computers did not get used by teachers in the other departments, and if so, are the reasons given related to the nature of the computer itself, the teachers, the pupils, the heads of departments, the curriculum, or combinations of all these ?

These issues were further highlighted in an article in Computer Weekly on the Scottish Microelectronics Development Project (Hearst, D. 1982). This article reported that the external evaluators of the SMDP found a number of factors inhibiting the use of microcomputers in Scottish schools. The main ones being a lack of teacher training, and the widespread sense of isolation and poor communication between the Programme and schools. They felt that the SMDP had built up the impression that success lay in the number of machines it could distribute, not the use to which they were put. They concluded that it was "one thing to put microcomputers into schools but quite another to incorporate them properly into the curriculum".

Although attempts have been made by the MEP, for example, to address some of these important issues of hardware, software development, software implementation across the curriculum, and teacher-training, it would seem that a lot more work needs to be done to understand the underlying issues of how and why teachers use or do not use computers. Furthermore, there seemed to be the need to carry out research that would provide a basis for the design of learning experiences with computers, and thus provide frameworks of models of learning, teaching and the organisation of knowledge in the use of computers in teaching. This understanding of computer implementation and innovation would, in-turn, contribute to the planning and development of appropriate teacher-training schemes, software development projects, and the actual use of computers in the school and classrooms.

These concerns were supported by the Social Science Research Council's report (Sage, M. and Smith, D.J., 1983) which stressed, among other things, that,

"The factors which inhibit or promote the adoption of computers and related devices by teachers are not known or understood. Quantitative inferential data-gathering techniques seem unlikely to illuminate the plethora of personal social and professional interactions which are probably involved. It is considered that there are grounds for case studies for a relatively small number of schools. Such studies might be expected to contribute to our understanding of curriculum diffusion processes, and should also provide practising teachers with aids to the analysis of their own problems." (para. 5.13.1).

The authors thus proposed that specific initiatives be commissioned which included,

"For Immediate Implementation : A series of linked case-studies to investigate the factors which promote or inhibit the uptake of the new technology and its implications by schools.

For Eventual Implementation : A study of management strategies in the introduction of IT in education." (para. 1.6.1).

The focus of this research study is thus aimed to address some of these issues, particularly that of providing an understanding of how teachers perceive computers within their organisational setting, and how the management and leadership styles and strategies of decision makers within the organisation of a school promote or hinder the implementation of computers.

2.0 THE RESEARCH RATIONALE

In order to understand a situation where computers were being introduced into a number of departments in the school, it was considered necessary to be within the school to observe and chart the history of this implementation. More importantly however, it was crucial to be able to talk to the teachers involved in this implementation, as individuals, and so to have a better understanding of the opinions of these teachers towards computers and computers in teaching.

Teachers, however, are not alone. They are within departments which, in-turn, are within the organisational setting of a school. These departments are run by department heads who not only have their own perceptions about computers, but also have views and opinions on how they see the management of people and resources within their department, and in this case, the management and use of computers in their departments. It would be helpful to explore the extent to which these department heads shape and influence the teachers within their departments. In addition, this analysis was extended to the level of the school, to understand the strategy adopted by the Headteacher in introducing computers into the entire school, and to see whether it had any influence (and to what extent) on the department heads and teachers. It is noted by the researcher that it would be helpful to see how all these would eventually affect the actual pupils, but due to the limitations of time and resources, it was decided that the research would not include the pupils' perceptions of computers and the use of computers in their lessons.

It was also necessary to see which factors, or combinations of factors, were more dominant in the eventual takeup or non-takeup of computers within the school. This meant that we had to look at the

situation in the school some time later. A period of one and a half years was then chosen to obtain a picture of the uptake of computers within the departments and within the school.

Thus, in order to get an overall picture of what influences were at work in the uptake of computers, a description of the various levels of the school and how they interacted with each other was considered necessary. For this reason, a case study was used. The case study allowed the possibility of looking at the teacher as an individual, that is, how he or she saw computers in general and how they reacted to them in terms of their teaching. It also looked at teachers within departments and sought to describe how they functioned as a group of people, with the dynamics that motivate such groups. And lastly, it sought to understand how departments fitted within the general pattern of the school and the policies of the Headteacher. So the study was designed to tackle the problem of implementation of computers in the school at three levels - the individual, the department and the school, and to attempt to articulate how these levels influenced each other.

3.0 THE RESEARCH STUDY

This research study was based on a medium size comprehensive school in England, which we shall call Barnaby Comprehensive. At the time the research was conducted, there were 1,300 students on roll, with over 160 pupils in the 6th form. Pupils in the lower school worked in mixed-ability classes for History, Geography and the Arts, but for Mathematics, English, Science and Modern Languages, they worked in groups according to their ability. Banding was more distinct when it came to the options work in the upper school.

There were two main reasons why Barnaby Comprehensive was chosen as the school to be studied. Firstly there existed a unique opportunity due to the fact that the school had recently purchased seventeen BBC Computers. Funds were obtained through various sources including organised fund-raising events and through the Parents Association. Twelve of the computers were for the newly formed Computer Studies Department, with the other five computers being purchased for the five major departments in the school (i.e. Science, Mathematics, Geography, History and Business Studies Departments). Within these departments, they were intended to be used specifically for

Computer Assisted Learning (CAL) applications. The researcher's main interest was in the use of the computers in these departments.

Secondly, the researcher was employed by the school as a part-time teacher at the time the research was about to begin. Although the part-time "job" was for only three hours per week (in the first two years) and an hour a week (in the third year), the researcher spent an average of two days a week in the school carrying out the research study, with more days spent per week during the stages when the interviews with different members of staff were carried out. Being a part-time teacher in the school proved to be tremendously helpful because the teachers saw the researcher as being "one of them" and not as an outsider intruding into the business of the school. Backing was provided by the Headteacher and some of the members of staff for they too were keen to see how teachers would use or not use the computers being purchased. The problem of objectivity is recognised as the researcher's mere presence can be seen as an "interference", but this problem is acknowledged in social-science research. To what extent the researcher should participate in the computer activities happening in the school was a more critical question. The role decided on in the end, as earlier mentioned, was that the researcher would merely be an observer-teacher who was interested in the use of computers in schools.

3.1 The Research Stages and Data Collection Instruments Used

The main study was conducted in three major stages over the period of the summer of '82 to the summer of '84. The chief form of data collection adopted was via semi-structured interviews, although questionnaires were used when more straight-forward information was required. The semi-structured interview was chosen, as it gave more flexibility in ascertaining views and opinions, and in probing into specific areas when it was felt necessary. The interviews were generally conducted in an empty office in the school and normally lasted about 45 minutes during school hours, although there were some interviews that had to be conducted outside school hours as teachers were very busy during the school day. All of the interviewees were asked if the interview could be tape-recorded, and permission was given by all except the Headteacher. Confidentiality of data was assured before each interview with the assurance that all names eventually used would be fictitious.

The first major stage of the research (June '82 to October '82) was to observe the operation of the school. This consisted of a series of interviews with some of the staff in the school including the Headteacher and the heads of seven departments. It meant looking at the way departments generally decide on the syllabus to be used, the assignment of teachers and the purchase of resources for example. This also meant finding out how policies were discussed, made and carried out within the school and departments, who made most of the decisions, and the roles and range of practices of teachers within the departments. These interviews were recorded and detailed notes made from the recordings. Part of the first stage of the research consisted of finding out the considerations of the Headteacher and the heads of departments before any curriculum development was carried out, and the way they would introduce it to the school. Special attention was paid to their considerations and strategies for implementing the use of computers in the school and within their departments. A short history of the arrival of computers into the school was also written up at this stage based on interviews with the Head of Physics and the Headteacher. This stage coincided with the time when the BBC computers actually arrived into the school, although there were already two PET computers (plus a couple of Sinclair computers) being used, mainly by the school's Computer Club.

The second major stage of the research (November '82 to April '83) was to elicit, again via semi-structured interviews, teachers' views and opinions about computers in general and the use of computers in teaching. This second stage started off with an initial plan of interviewing all of the teachers chosen regarding their views on various teaching methods and resources, together with their views about using computers in their teaching. After the first two interviews, it was realised that the data collected was very lengthy and difficult to analyse because of the open-ended nature of the enquiry. It was then decided to start off with a short questionnaire, allowing data to be collected and analysed more systematically. This questionnaire was designed to find out the views and opinions of teachers on various teaching methods and resources. One of the points of interest in the research was to see whether the views and opinions that were expressed by the teachers with regards to their use or non-use of teaching methods and resources, would be predictive of their eventual use of computers in teaching. If it could be roughly predicted, then it would be useful to isolate the factors that enabled such a prediction to be made. This was then followed-up by another questionnaire to

obtain the biographic details of the interviewees (for example, qualifications, number of years of teaching), and hence provide a context and background to the study of the teachers who were being interviewed.

The major part of this stage, and of the research study, was the series of interviews with the teachers in the five departments of the school. Initial pilot work was carried out with a teacher in another school to see whether the questions planned for these interviews were appropriate. The aim of these main series of interviews was to assess the attitudes that teachers had toward computers in general and the use of computers in teaching, and teachers were urged to develop their ideas on each of these areas. In the assessment of teachers' views and opinions, focus was put on understanding the factors that influenced the use or non-use of computers by the teachers. Another purpose of the interviews was to find out the organisational problems that teachers perceived they encountered or would encounter when attempting to use computers in their teaching, and who, they thought, should or would be able to solve some of these problems. In addition, teachers were also asked about their reactions to the leadership styles and strategies of their heads of departments (and Headteacher) in implementing the use of computers in their department (and in the school).

The other part of this second stage was to find out, again by another series of interviews, the strategies, if any, that the heads of the five departments had with regards to the purchase and the method of introduction to the use of computers in their departments. This was extended to the Headteacher of the school to see the strategy that he employed in the implementation of computers into the entire school. At a later stage, it was important to see whether these strategies were practical and effective within the different departments concerned as well as the school. Both series of interviews at this stage were recorded and transcribed.

The third major stage of the research study was held in the summer of '84. This consisted of another series of interviews with the teachers and heads of departments in the five departments of the school, including the Headteacher. The aim of this series of interviews was to record any change of attitudes that teachers may have had about computers in general and the use of computers in teaching, the perceptions that they had concerning the organisational problems or solutions encountered in the

use of computers, and whether there were any changes in their actual use of computers, after a period of one and a half years. In addition, teachers were also asked about any changes they might have in their reactions towards the strategies and leadership styles of their heads of departments in introducing the use of computers.

Another series of interviews was also conducted with the heads of departments (and the Headteacher) to record the perceptions that these decision-makers had concerning the progress, or lack of progress, of their strategies, and of the actual uptake of computers in teaching, in their departments and in the school, one and a half years later. Again, both series of interviews at this stage were recorded and detailed notes made.

3.2 The Research Sample

The sample was determined by those departments that had decided to purchase a computer for use within their department. The assumption was that the teachers in these departments would have a greater chance to use computers. The five departments spanned some of the major curriculum divisions of the school and consisted of the Science (which included Physics, Biology and Chemistry), History, Mathematics, Geography and Business Studies Departments. It was important to see whether the different subject disciplines (for example, the Sciences, the Mathematics and the Humanities) and the teachers within these departments would perceive computers, and the use of computers in teaching, in different ways.

Although the choice of departments was largely determined by external circumstances, the selection of teachers was done so as to provide a range of teaching experience in the sample and including the decision-maker of the department, taken to be the head of department. The assumption made was that teachers with varying years of teaching experience would have, if any, different experiences of computers and the use of computers in teaching. Thus, for each department, teachers were selected to cover the policy-maker of the department, an "experienced" teacher and a "non-experienced" teacher, as defined by years of teaching experience. On average, three or four teachers were selected from each department (depending on the size of the department). The only exception was

the Business Studies department where there were only three teachers of different subject disciplines (Economics, Sociology and Commerce) and so only the head of department, who was also the Economics teacher, was selected, as he was the teacher most willing to be interviewed. Also, it was unfortunate that the head of Mathematics was busy most of the time and so felt unable to give the time needed by the researcher to carry out the interviews with him. He was, however, willing to fill in a questionnaire that briefly covered the same areas intended to be covered by the interviews (but unable to cover it to the same depth). The choice of sex in the sample was purely by default and had no part to play in the selection procedure. In the end, 15 teachers including heads of departments, were chosen for the sample.

3.3 The Research Analysis

Some of the teachers, on their own free will, began to talk about how they saw themselves (i.e. their self-concept) and also how they saw themselves in relation to using computers. A few also talked about how they viewed their teaching as they felt it important to mention this in the context of their views and opinions regarding the use of computers in school. These interviews were mainly analysed at three levels - at the level of the teacher, the department and the school.

To analyse these interviews more coherently at the level of the individual teacher, a series of categories were chosen. These categories arose partly from theory and partly from the data, although not all of the categories were relevant to all of the teachers. Thus, teacher profiles were drawn up to summarise what they had said under each of these seven categories :

- Biographic Data.
- Initial Contact With and Attitude Towards Computers.
- Self-Concept.
- Attitude towards Teaching in General.
- Attitude towards Computers in General.
- Self-Concept Related to Computers.
- Attitude towards Computers in Teaching.

It was realised when the interview transcripts were being analysed and the teacher profiles written, that the teachers' replies were being addressed mainly to three areas or domains (although not all the teachers necessarily talked about all the 3 domains). These three domains were recognised to be their views about computers in general, their views about the use of computers in teaching, and their views about the use of computers in school administration. Within these three domains, there appeared three main groups of positive, negative and neutral views held by the teachers about computers. These could be further sub-divided, for example, amongst the positive group, most of them had certain reservations (either criticisms or worries) attached to their positive views; similarly, amongst those who were negative in their views towards computers, there were those who saw computers as unhelpful and those who had a real fear or were totally against computers. Thus, eight categories were formulated, including one category for those teachers who did not mention anything at all. These categories are defined as follows :

1. The **Favourable (+)** category has to do with perceptions held by teachers about computers that are very positive. They are teachers who are enthusiastic about, impressed by or interested in computers and find them useful. These teachers perceive computers as fascinating, bemusing or impressive.

2. The **Critical (+C)** category includes all teachers who are impressed and enthusiastic about computers but have several critical comments about the way they should be used or about the hardware and software associated with computers.

3. The **Worried (+W)** category includes all teachers who are impressed and enthusiastic about computers but have several worries or fears about their use in and implications for society, themselves and their teaching situation.

4. The **Unfavourable (-)** category has to do with perceptions held by teachers about computers that are negative. They are the teachers who regard computers as unhelpful and as not achieving any real purpose. They consist of teachers who view computers as "toys" and thus not important for any

real "work". They also include all those teachers who are worried about the use of computers and have no positive opinion regarding their use.

5. The **Antagonistic (-A)** category describes teachers who are insecure, very afraid or against computers. It includes the ideas that using computers in teaching will make their pupils dependent on machines, lazy in their thinking or incapable of expressing themselves. The teachers in this category are not prepared to envisage a way of teaching that would include the use of computers.

6. The **Indifferent (o)** category describes teachers who are non-committal and unsure about computers. They contain views of computers that are neither positive or negative but are more neutral, for example, those teachers who see computers as just another piece of machinery or as any other audio visual aid that will "collect dust most of the time".

7. The **Uninitiated (?)** category is for teachers who do not have any real perception or ideas about the use of computers in school and teaching. In other words, computers are an unknown entity to them as they have not really used computers neither do they know anything about them.

8. The **Not-Mentioned (NM)** category is for those teachers who did not mention any opinions at all about computers.

The teachers' interviews were also analysed at the level of the department as "Department Profiles". Each department profile includes a simple factual description based on the interviews conducted with teachers, and an impressionistic account based on conversations and observations made in the school. The aim of these profiles is to insert the teachers' views and opinions about the use of computers into the context of the department. In order to achieve this, the comments of the teachers about his/her department's or department head's decision to purchase a computer (the BBC microcomputer), and the organisational problems or "snags" that they perceived they would encounter in the use of computers in the department are analysed.

To facilitate analysis, these department profiles have been sub-divided into several categories which include :

1. **An Overall View.** An initial description of the make up, teaching and leadership styles and resources of the department -

(a). **Composition.** A factual statement of the number and the nature of staff and pupils in the department. This would include the ages, roles and responsibilities of the teachers in the department; and the size of the department with respect to the number of pupils it is teaching (for example, CSE, "O" & "A" levels) for the academic year '82/'83.

(b). **Teaching Practice & Support.** A description of the more common teaching methods or styles used by the teachers in the department; the administration and opportunities for discussion provided by the department; and the teaching resources of each department, including its capitation and rooms provided. Mention is also made of the number of computers available in the department at that time, and the location of the computers.

(c). **Impressions.** An overall view of the department by the researcher with specific references to the head of department, the relationships between teachers and the relationships between teachers and the head of department.

2. **Teachers' Organisational Profiles.** This is similar to the teacher profiles in that it is a description of each of the teachers' views and opinions towards the use of computers, but in the context of the organisation and running of the department, together with the constraints they perceive they would find.

3. **Strategies & Politics.** An analysis, at the interpersonal level, of the head of department's strategy (in the purchase and the method of introduction of the use of computers in the department) and the perceptions and reactions of the staff towards that strategy. The main emphasis is on looking at departments and the interaction between the teachers within the department and its head.

It was felt at this point that a more useful model was needed to help out with the analysis. Lundgren's Frame Factor Theory (1972) was of interest as it provided a framework which indicated the different kinds of factors (or frames) that might be involved in any form of curriculum innovation. Frames, as used by Lundgren, are boundaries which are established at different levels above the teaching process - at the teaching, school and educational system levels. The decisions made at the educational level will thus be the frames for decisions on the teaching and school levels; and the decisions at the school level will act as a boundary for any possible decisions at the teaching level. Lundgren thus viewed the teaching process as context bound. It was seen as being determined by rules that regulate (for example, the strategies of the decision-makers, called the Formal-Rule System), frames that form a boundary (i.e. the organisational constraints and solutions, called the Frame System) and goals that govern (i.e. the curriculum, called the Goal System) the teaching process. A fourth system, the Attitude System, was added to reflect the views and opinions of the teachers towards audio-visual aids and computers (in general, in teaching, and in administration). This is shown diagrammatically in Figure 2.

A comparison of the strategies and leadership styles of the heads of departments was based on the set of categories formulated by White and Lippitt (1968) on leader behaviour and member reaction. In this research study, the leadership styles were categorised under the three headings of autocratic, democratic and laissez-faire, and is summarised in Figure 3. Teachers' perceptions of the use of computers at the different levels of department and school were then represented as driving or opposing forces using ideas from Lewin's (1952) Force Field representations. Lewin saw behaviour in an institutional setting as a balance of forces (represented by arrows) working in opposite directions. Change takes place when the forces on one side are greater than the forces on the other side. This is shown in Figure 4.

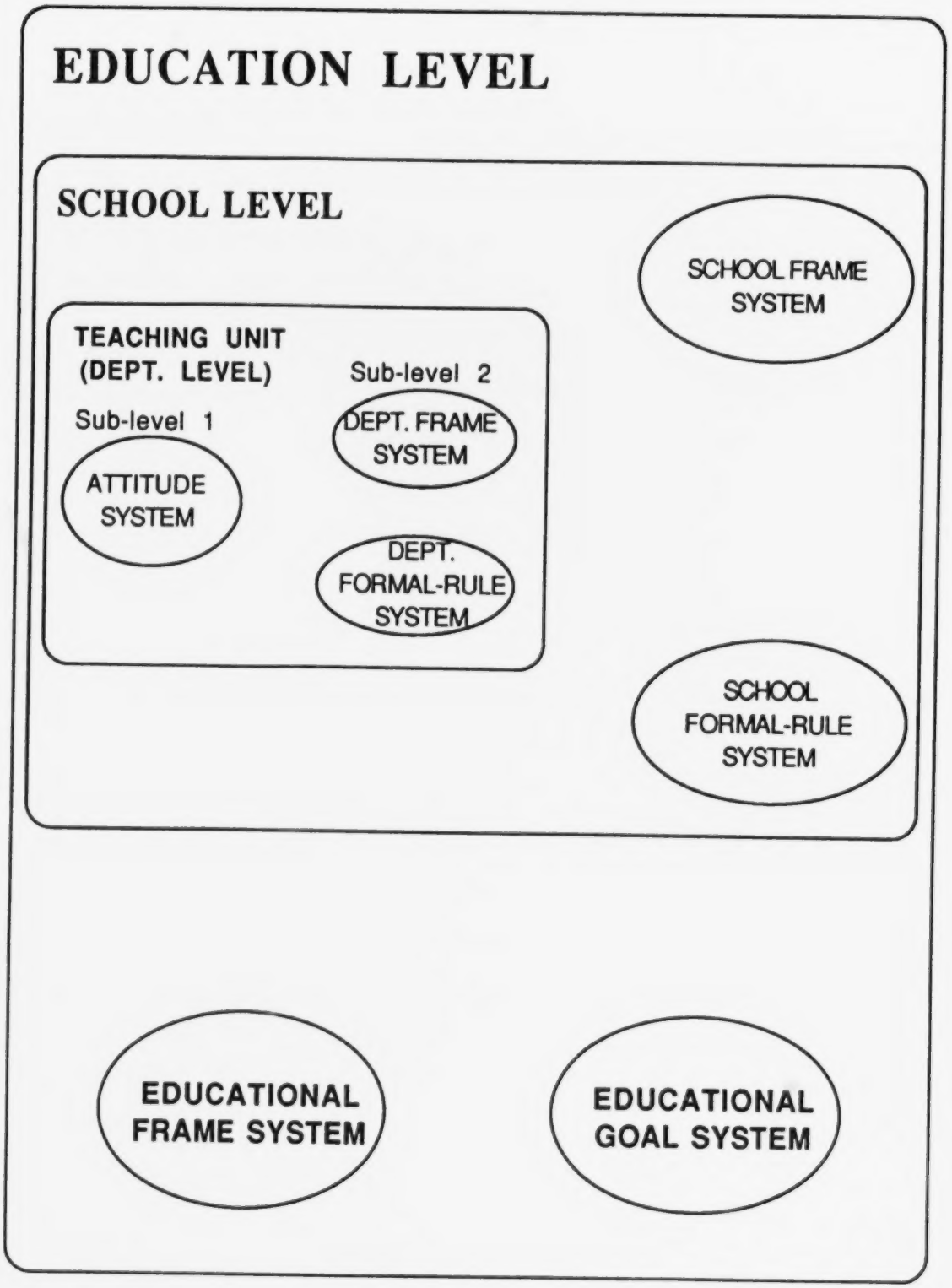

Figure 2 : Adaptation of Lundgren's Systems

CHARACTERISTICS OF LEADERSHIP STYLES (WHITE AND LIPPITT)

AUTOCRATIC	DEMOCRATIC	LAISSES-FAIRE
1. All determination of policy by the leader.	1. All policies a matter of group discussion and decision, encouraged and assisted by the leader.	1. Complete freedom for group or individual decision, with a minimum of leader participation.
2. Techniques and activity steps dictated by the authority, one at a time, so that future steps were always uncertain to a large degree.	2. Activity perspective gained during discussion period. General steps to group goal sketched, and when technical advice was needed, the leader suggested two or more alternative procedures from which choice could be made.	2. Various materials supplied by the leader, who made it clear that he would supply information when asked. He took no other part in work discussion.
3. The leader usually dictates the particular work task and work companion of each member.	3. The members are free to work with whomever they chose, and the division of tasks was left up to the group.	3. Complete non-participation of the leader.
4. The dominator/leader tended to be "personal" in his praise and criticism of the work of each member; remained aloof from active group participation except when demonstrating.	4. The leader was "objective" or "fact-minded" in his praise and criticism, and tried to be a regular group member in spirit without doing too much of the work.	4. Infrequent spontaneous comments on member activities unless questioned, and no attempt to appraise or regulate the course of events.
LEADERSHIP STYLES AND GROUP BEHAVIOUR UNDER THESE STYLES		
1. Can create much hostility and aggression (for example, aggressive demands for attention, destruction of property), including aggression against scapegoats (i.e. concentration or polarization of group aggression against a single "innocent" object or person).	1. More efficient than autocratic and laissez-faire (in terms of achieving "work" and "social" goals).	1. Less organized (they played more), less efficient (less work done and poorer work); less satisfying.
2. Can create discontent that does not appear on the surface. This can create a certain amount of • subdued atmosphere where spirits are damped down and group kept soberly at work; • "comradeship" as they recognise themselves as being in the "same boat".	2. More interest and motivation shown in work - kept on working when leader left.	2. More characterised by play.
3. More dependance and less individuality.	3. Higher level of originality or creative thinking.	3. Group preferred democratic leader.
	4. More group mindedness, friendliness and mutual praise.	

FIGURE 3

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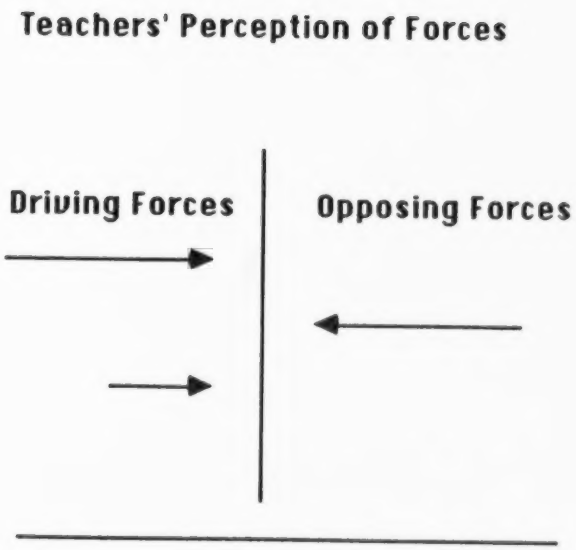

Change occurs if the balance or resultant of either the Driving Forces or the Opposing Forces becomes greater than the other.

KEY :

Length of line is proportional to the magnitude/strength of force.

Figure 4 : Lewin's Force Field Model

A modification of Lewin's representation is to provide a scale at the bottom of the diagram to show the magnitude of movement, i.e. to show the increase (or decrease) of usage of computers (but only very qualitatively) over the one and a half year period that the use of computers was monitored in Barnaby Comprehensive. No attempt is made at all to measure the quantitative uptake of computers or to represent these in Lewins' force field diagrams. What is represented are relative changes in the use, or non-use, of computers within the departments and school. Lewin's force field representations in the research study was thus used only to pictorially show and describe dynamically the magnitude and direction of these factors of change.

This analysis was then extended to the level of the school. It looked at the perceptions teachers had towards the organisational constraints and solutions at the school level, the strategy of the Headteacher, and the reactions of the teachers toward the strategy and policy of the Headteacher. Some teachers also made mention of outside influences which they perceived would affect the use of computers in the school. Although the research did not set out to thoroughly cover these issues, they were however included if they were mentioned by the teachers themselves.

The analysis ends with a very brief picture of the actual use, or non-use, of computers by these teachers, and of the progress, or lack of progress, made by the heads of departments in the implementation of computers in their departments, one and a half years later. A general description of the "state-of-play" regarding the use of computers within each department was provided with a description of how teachers perceived the "success" of the initial introduction of computers. The analysis then concludes with a discussion about the possible factors, or combination of factors, that might have been critical in encouraging or hindering the use of computers in the departments and school.

4.0 THE RESEARCH FINDINGS

4.1 Teachers and Teaching Methods and Resources

A preliminary study was first carried out to find if teachers automatically thought about using computers when asked about teaching methods and resources. This question had to be asked carefully without making the teacher feel that the researcher was trying to find out whether he/she was "good" or "bad" as an innovative teacher. To prevent the teacher from feeling threatened, the researcher decided to look at the teachers' views about teaching methods and resources only in general and not in any thorough detail. It was thought that an interesting outcome of the study would be to find out, whether the views and opinions expressed by the teachers toward teaching methods and resources could be an indication of their eventual use of computers in teaching. It was also thought that the isolation of factors that would enable such a prediction to be made would be useful. Eventually, it was decided that the survey could best be conducted in the form of an open-ended questionnaire. This meant that the amount of data collected could be kept small (only the number of lines given, any further pages of information being attached as necessary), and yet still be kept open enough to include any other important data.

The questionnaire was analysed according to the teachers' perceptions of the teaching resources/aids and teaching methods that they would have liked to use in a situation of no constraints (i.e. an Ideal Situation or World) as compared with what they actually used in their everyday work (i.e. in the Real Situation or Real World). This was done so as to understand what and why certain resources and methods were used and others were not. What emerged was that there was a difference in the nature of the resources that were suggested between the two situations of ideal and real worlds. For example, the teaching resources that teachers used in their teaching were resources that were technically less complex, where there was a minimum amount of preparation required, and where the teachers' main role would be as the sole imparter of knowledge. Thus, it was not surprising that the use of the OHP, blackboard and textbooks were the main teaching resources mentioned. Similarly, it was found that the reasons teachers gave for the types of teaching methods they wanted to use, in a situation where there were no constraints, were mainly pupil dominated. They wanted to use these

methods as they perceived that it would help their pupils in the learning of the various subjects. However, in their normal teaching activity, the teaching methods that teachers used were different, and the reasons given were mainly constraint reasons, personal as well as organisational constraints. This gap between what was used and what was hoped for grew wider from the History to the Geography to the Science departments, and became more so in the Mathematics department where teachers could not perceive of using teaching methods where there were no constraints at all. Already it was found, at even the initial stages of the research, that there was a wide difference in the reasons for using various teaching styles and methods in the departments of the school.

There was generally a very low level of awareness amongst teachers about computers, especially the use of computers in teaching, even in a situation where there were no constraints. This was brought out by the fact that when teachers were asked about what teaching resources and methods they would use in a situation of no constraints, only five teachers mentioned the use of computers. The only real uses made were in simple wordprocessing, and with a single teacher using the computers once a year for her class. Furthermore, it was recognised that without a conscious prompting from the researcher, the teachers could not imagine a situation where computers would play an important part in their teaching and in the school.

4.2 Teachers and Computers

4.2.1 Teachers' Perceptions About Computers in General

When the fifteen teachers interviewed talked about their views and opinions regarding computers in general, they made comments on one or both of the following dimensions :

(a). The types of feelings teachers experienced towards computers.

(b). The perceptions that teachers had about the capabilities of computers; and the types of effects computers have, good or bad, on people and society.

Looking at the teachers' comments about their feelings and/or the effects they perceived computers were having on people and society in general, the overall picture is that while there was a tendancy to think positively about computers (they were fascinated, impressed and interested about computers, and saw them as an important and useful tool and a growing influence in education), over half of them had reservations of one kind or another.

Some of them had quite deeply rooted worries or criticisms about computers in general. These worries had to do firstly with the possible abuse of power that computers afford as a result of its capabilities in storing and accessing large quantities of personal data; and secondly with the feelings of inadequacy that arose because of an ignorance about computers and the terminology used. The criticisms the teachers had included the views that the use of computers would demand a greater level of ability and commitment that would be required of them.

There were teachers who were unfavourable towards the use of computers associating them only with mathematical and statistical disciplines. Others were antagonistic perceiving the use of computers as encouraging lazy thinking, or even worse, as "brainwashing" instruments. The perceptions of the individual teachers towards computers in general were summarised in Figure 5.

4.2.2 Teachers' Perceptions About Computers In Teaching

When the teachers' perceptions about computers in teaching were examined more closely, they were seen to be talking about one or both of the following two areas :

(a). There were those teachers who viewed computers as teaching aids or resources.

(b). There were those teachers who viewed the use of computers as a form of teaching, i.e. as a teaching method.

The majority of the teachers saw the computer as a teaching aid or resource. The favourable teachers saw computers as useful, quick and dynamic visual displays for difficult concepts, as statistical tools,

TEACHERS' PERCEPTIONS ABOUT COMPUTERS IN GENERAL :

S/NO	TEACHER	TYPES OF FEELINGS EXPERIENCED	CAPABILITIES & EFFECTS OF COMPUTERS	OVERALL VIEW
1.	Cane	• * Excited on the intellectual stimulation of it	• * A growing influence.	•
2.	June	+V Being in control of the comp. * Marvellous though difficult * Not efficient in it because of lack of experience	NR	+V
3.	Mikado	• * Liked it.	• * Growing importance in ed.	•
4.	Behr	NR	• * As a tool for analysis.	•
5.	Johnson	• * Fascinated with potential of computer	+C * Complex machines demanding a higher level of ability & commitment. * Technical mystery/wizardry.	+C
6.	Joachim	• * Skeptical. * Not wildly enthusiastic.	• * A piece of machinery to be used.	•
7.	Ridley	NR	• * Access to databases for job info.	•
8.	Malory	NR	- * Associated only with Maths & Stats.	-
9.	Coleridge	• * Amazed & astounded over computers' ability. * Interested in uses for school & classroom.	NR	•
10.	Constance	+C * Enjoy pumping in data but important to know how comp. interprets data.	NR	+C
11.	Hugo	NR	-A * Makes people mentally lazy. * Makes people dependant on computers. * A "brainwashing" instrument. * No educational advantage.	-A
12.	Joule	+V *Impressed with what it can do. * Worried of power it gives to individuals to store & access info.	• * Power to help handicapped.	+V
13.	Jackson	NR	+C * Just a big-size calculator. * Helps her pupils but not herself.	+C
14.	Sully	+C * Computers *ought to* be used in schools because more people in society are using computers.	NR	+C
15.	Rubens	+V * Interested in it. * Not so frightening as it looks. * Worried that computer-terminology used is off-putting.	• * Useful	+V

SUMMARY TABLE			
NO.	TYPES OF FEELINGS EXPERIENCED	CAPABILITIES & EFFECTS OF COMPUTERS	OVERALL VIEW
15	10 with Comments 5 No Comments (NR)	11 with Comments 4 No Comments (NR)	
	6 • 2 +C 3 +V 1 •	6 • 2 +C 1 • 1 - 1 -A	3 • 4 +C 3 +V 1 • 1 - 1 -A

Figure 5

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and as means of reinforcing learning through the visual medium. Some others were critical about computers, seeing computers as marvellous motivational and teaching tools, but having reservations about the quality of educational software, the danger of computers encouraging nothing but games-playing, and the problems of infrequency of use, i.e. that they are just part of a teaching package that will collect dust most of the time.

Those that were unfavourable towards the use of computers saw them as only "toys" or "glorified calculating machines" and not suitable for work, or as being mis-used and treated as just a gimmick, while others saw them as poor forms of storage and information retrieval units. Finally there were those who were indifferent to the use of computers, seeing computers as just another type of audio-visual aid or just as an aid to teach programming. The perceptions of the individual teachers towards computers in teaching were summarised in Figure 6.

All the teachers in the sample saw computers as a form or way of teaching, i.e. as a teaching method. In addition, all of these teachers had either deep reservations or were against the use of computers in teaching. They saw the use of computers as requiring some changes.

4.2.3 Teachers' Perceptions About Computers in Teaching as Changing their Role

It became apparent that most teachers felt that the use of computers would necessitate some changes. They described themselves as having to be different sorts of teachers because using computers in classrooms would involve new and different skills in classroom management. As a result of the use of computers, they also perceived that their teaching situation may be different. In the analysis, therefore, these ideas have been categorised within three areas:

1. In Authority. There was the change that teachers perceived would occur in themselves with regards to their being seen as in charge or in control when computers were used in their classroom situation. This involved their perceptions about the organisation and management of the class, especially with respect to discipline and control.

TEACHERS' PERCEPTIONS ABOUT COMPUTERS IN TEACHING :

S/NO	TEACHER	AS A TEACHING RESOURCE/AID	AS A TEACHING METHOD	OVERALL VIEW
1.	Cane	• • A useful, quick and dynamic visual display for difficult concepts.	+W • For individual & small group work, for top and bottom groups. • Worried about class management.	+W
2.	June	NR	+C • A different way of looking at things which stimulates pupils to think. • A hindrance if pupils don't know what they are doing.	+C
3.	Hikado	+C • A marvellous motivational tool. • Slow loading. • Poor software.	• • Individualised Learning.	+C
4.	Bohr	+C • For teaching computing. • For high-speed calculation. • Poor educational software.	+C • Danger of substituting practicals or experiments.	+C
5.	Johnson	+C • "Live" teaching aid. • Elitist toy. • Encourages games playing.	+C • Creates two levels of teaching/teachers.	+C
6.	Joachim	- • Would not use it as a gimmick or for "computer sake".	- • Change in teachers' role, power and authority.	-
7.	Ridley	o • Same as any AV aids.	- • Involves planning, pupil discipline & organisation. • Worried about computers being damaged by pupils.	o
8.	Malory	• • Isolates weak senses and reinforces learning through visual sense.	+W • Interaction on the individual level and small groups. • Worried that only the able pupils will get a chance and the less-able pupils will loose out.	+W
9.	Coleridge	+C • Only part of a package - will collect dust most of the time. • Remedial work. • Challenges traditional role of teachers.	• • Allows pupils to go at their own pace and test, in a model sense, different calculations.	+C
10.	Constance	• • A statistical tool.	+C • For simulations in small groups. • Not an end in itself.	+C
11.	Hugo	- A poor storage & retrieval unit	-A • Eventually comps might replace the classroom situation, teachers and the giving of info.	-A
12.	Joule	- • Just a toy, not important for work. • A glorified calculating machine.	o • Just happy to be a teacher.	-
13.	Jackson	NR	-A • Not prepared to deviate from normal way of teaching. • Dept geared to comps instead of teachers.	-A
14.	Sally	• • Aid to teach programming.	? • "I don't know what you mean."	?
15.	Rubens	NR	+W • Useful back-up for demonstrations and simulations. • Afraid that computers will heighten maths aspect of Economics and so discourage pupils from using comps. • Programmed learning format - for individual and small groups.	+W

SUMMARY TABLE			
NO.	AS A TEACHING RESOURCE/AID	AS A TEACHING METHOD	OVERALL VIEW
15	12 with Comments 3 No Comments (NR)	15 with Comments	
	3 • 4 +C	3 • 4 +C	6 +C
	2 o	3 +W 1 o	3 +W 1 o
	3 -	1 ? 2 -	1 ? 2 -
		2 -A	2 -A

2. As An Authority. There was the change that teachers perceived would occur in themselves with regards to being seen as an expert in the use of computers. This involved their own perception about themselves in using computers, and also whether they saw themselves as competent and hence confident in using them.

3. Their Teaching Situation. There was the change that teachers perceived would occur in their teaching situation, for example, with respect to group size and composition, or in the transmission of knowledge in the classroom.

These perceptions of the individual teachers towards computers as requiring some form of change were summarised in Figure 7.

Over half of the teachers saw the changes in themselves **in authority** as unfavourable. All of them specifically commented on worries or fears concerning class control especially with pupils who might tamper or damage the computers either through mis-handling or shere violence. Some of these teachers commented that the less-able or dull pupils with behavioural problems might be the main culprits of this.

The majority of teachers had unfavourable views about themselves **as an authority** (their own competence and confidence in using computers). They saw it as important to be familiar with computers and not ignorant or inefficient in the use of them. They however expressed the feeling that they felt either "old", "inadequate", "not-practical", "slow", "uncreative", "unimaginative" or "unadaptable" in acquiring the necessary skills and knowledge to use computers; or in the case of one teacher, to write suitable software. One of the teachers saw the acquiring of new skills and knowledge as involving a lot of learning on her part. Some teachers saw themselves as "not logical" or "not scientific", qualities which they felt were essential if they were to use computers, while others were worried that the use of computers might create two levels of teachers - those who knew about computers, and those who did not see themselves to be an authority in the use of computers in teaching.

TEACHERS' PERCEPTION OF CHANGE :

S/NO	TEACHER	OVERALL CHANGE	VIEW OF TEACHING IN GENERAL	PERCEIVES CHANGE TO OCCUR IN THEMSELVES		THEIR TEACHING SITUATION
				IN AUTHORITY	AS AN AUTHORITY	
1.	Case	Yes, +&-	HN	Y,- * Handle diff. grps with diff. needs. * Tampering with the computers.	HN	Y,+ * For remedial work. * For two extreme ends of pupil ability range.
2.	Jane	Yes, -	HN	HN	-ve * Old * Unadaptable * Ignorant. * Inefficient because of lack of experience. * Inability to learn quickly.	Y,- * Brighter pupils getting most benefit.
3.	Mikado	Yes, +	HN	HN	+ve * Scientific, mathematical & logical turn of mind.	Y,+ * For low-ability pupils. * Individualistic.
4.	Bohr	Yes, -	HN	HN	HN	Y,- * Could not replace teaching system but danger of substituting experiments.
5.	Johnson	Yes, -	HN	HN	-ve * Creates two levels of teachers - those those who know and those who don't.	Y,- * Becomes selective toy for brightest or dullest pupils or a selection of middle pupils.
6.	Joachim	Yes, -	Y,- * Fairly traditional. * Teaching is personal. * First few years is spent in learning the trade.	Y,- * Teacher must be competent, confident & in control of the class to prevent computers being damaged.	-ve * Not scientific. * Not logical. * Rough with equipment. * Competence to teacher implies being pragmatic & creative; and knowing the "ins and outs" of the computer & programming.	Y,- * Different type of discipline & work ethic. * Change in role, relationship, power & authority between teachers and pupils.
7.	Ridley	Yes, -	HN	Y,- * Involves planning, pupil discipline & org. to prevent comps being damaged.	+ve * Not beyond his capabilities.	HN
8.	Malory	Yes, -	HN	Y,- * Computers being damaged by less-able pupils.	-ve * Inadequate to write suitable software.	Y,- * Only for small grps. * Only able pupils get a chance, less-able pupils loose out.
9.	Coleridge	Yes, +&-	HN	Y,- * Class control esp with dull children damaging computers.	+ve * Likes new areas & challenge.	Y,+ * Allows own pace. * Remedial work. Y,- * Pupils know more about computers than teachers which challenges traditional role of teachers.
10.	Constance	Yes, -	Y,- * Just surviving. * Everyday problem is the teaching of children.	Y,- * Problems with class control.	-ve * Not logical.	HN
11.	Hugo	Yes, -	Y,- * Pupils are over-exposed to AV.	HN	+ve * Good powers of obsv. * Like working things out mathematically in his mind.	Y,- * Eventually it might replace classroom teacher & situation and giving of info. * Makes pupils lazy, less knowledgeable & less capable in thinking & expressing themselves.
12.	Joule	Yes, -	HN	HN	-ve * Not imaginative and not creative to use computers.	Y,- * Demands from society will make change.
13.	Jackson	Yes, -	Y,- * Set in ways but will change if dept policy.	Y,- * Computers being damaged by pupils. * Deviates from normal way of teaching.	-ve * Slow in acquiring skills and knowledge. * Inadequate in providing guidance. * Not familiar enough.	Y,- * Dept geared to comps instead of teachers. * Makes pupils dependant on comps.
14.	Sully	Yes, -	Y,- Traditional in the way she teaches.	HN	-ve * Not practical. * Apprehensive. * Involves a lot of self-learning.	Y,- * Society will require pupils to be [illegible] comp
15.	Subone	Yes, +	HN	HN	-ve * "only a learner".	Y,+ * For individual work & group working by themselves.
SUMMARY		13 Yes 2 + 11 - 2 +&-	5 Yes 10 HN 5 -	7 Yes 8 HN 7 -	13 Yes 2 HN 4 + 9 -	13 Yes 2 HN 3+ 9 - 1 +&-

Only a small number of teachers had favourable views about themselves, seeing themselves as having a scientific, mathematical or logical turn of mind, or that they liked new areas and challenges and seeing the use of computers as one of those new challenges.

Again the majority of teachers saw the change that might occur with the use of computers in their teaching situation as unfavourable. These unfavourable reservations/changes included,

- the fear that the traditional roles of teachers would be challenged, or worse, that the teachers themselves would be changed or replaced, and that the department would be geared towards computers instead of teachers. One teacher went into greater detail, mentioning that this change would occur in the power and authority relationship between teacher and pupil. According to this teacher, this would mean a change in the "work-ethic" of the teaching situation where the situation becomes more "non-formal". However, he did not further elaborate what "non-formal" meant except to say that it may mean pupils working on their own, and that he sees his own teaching as traditional and hence "formal".

- the concern that teachers envisaged pupils becoming dependent on computers and becoming more lazy, less knowledgeable and less capable of thinking and expressing themselves.

- the change that would have to occur simply because society would require them (school and teacher) to do so in the end.

- the worry that there was a danger of using computers to substitute for practicals or experiments.

- the concern that the use of computers with small groups of pupils as being disadvantagous. Teachers believed that the computers would be used only for the brighter pupils and that the less-able pupils would loose out. One of the teachers felt that computers could become a selective toy for either the brightest pupils and/or the dullest pupils, or a selection of the middle-ability pupils because of the insufficient number of computers available.

Although the interviewer did not ask about the teachers' views about their teaching, a small number of teachers expressed how they felt about being a teacher. All of them had comments that had to do with negative aspects of teaching. Some regarded themselves as traditional in the way they taught, while others felt fairly set in her ways of teaching or that they were just existing/surviving one day at a time.

4.2.4 Teachers' Perceptions About Computers in School Administration

This question was not asked by the researcher, but just under half of the teachers voluntarily mentioned about their perceptions towards computers in school administration. This was summarised in Figure 8. It was found that out of these teachers, the majority who made comments had favourable views. They saw computers as useful databases (for recording, accessing and manipulating large quantities of data), and word-processors. As such, they felt that computers would be helpful for school administration, careers administration (school's references and job information), for documentation and printing extracts for pupils, and for producing worksheets, pupil profiles and reports for teachers.

Only one teacher was antagonistic in his views. He was mainly concerned about the use of computers in timetabling and in options work. He felt that computers could not provide him with the necessary information and so would be unable to keep him in constant touch with any problems arising in options work, or to manipulate the possible outcomes readily in options work.

It can thus be seen that these teachers were polarised to two extreme ends - they were either favourable towards computers in school administration or they antagonistic towards them. There were no teachers who had views in-between these two extreme ends.

4.2.5 Discussion

Some of the research conducted in the area of CAL merely tried to relate teachers' attitudes towards computers to biographical factors or past experience (Bolton and Mosow, 1981; Christopher, 1969; and Robardey, 1971). This research study attempted to discover in greater detail what teachers specifically thought about computers and the use of them in teaching. It became apparent that there

TEACHERS' VIEWS ABOUT COMPUTERS IN SCHOOL ADMINISTRATION :

S/NO	TEACHER	OVERALL VIEW	REASONS / USES
1.	Cano	NM	
2.	June	NM	
3.	Mikado	NM	
4.	Bohr	+	* For school administration. * As a database (for recording, accessing & manipulating large quantities of data).
5.	Johnson	+	* Wordprocessing for pupils (documents & extracts) and teachers (worksheets, pupil profiles & records).
6.	Joachim	NM	
7.	Ridley	+	* For Careers admin, for eg. writing of school's references. * As a database to access job information.
8.	Malory	NM	
9.	Coleridge	+	* Useful in an admin capacity for teachers.
10.	Constance	NM	
11.	Hugo	-A	* For options work, it does not provide data at fingertips.
12.	Joule	NM	
13.	Jackson	NM	
14.	Sully	+	* For storing information. * For school admin, for eg. timetabling.
15.	Rubens	NM	

Figure 8

was a distinction between how the saw computers in general (in society and in industry), and how they saw the use of computers in teaching and in administration. The teachers at Barnaby Comprehensive not only showed favourable or negative views towards computers, as was also shown by teachers in other studies (Bolton and Mosow, 1981; Robardey, 1987; Stevens, 1980; Stimmel et al, 1981; and Wayth, 1981), but there was in effect a whole range of views covering an extremely broad spectrum of attitudes within the five departments of the school. The cluster of negative views such as Unfavourable, Antagonistic and Indifferent, were often associated with a negative view of themselves, i.e. a negative self-concept. For example, those who were apprehensive about using computers also saw themselves as "not-logical", "not-mathematical", "old", or "slow". On the other hand, those teachers with positive views about computers (even though there were worries and criticisms attached to these views) rarely talked about themselves or their self-concept. In addition, those who had favourable comments about themselves (seeing themselves as "scientific" or liking new areas of challenges), also saw computers as not beyond their capabilities .

Stimmel et al (1981) found that teachers' views about computers were "oppressive". Such views were expressed by a number of teachers in Barnaby Comprehensive who, while having positive views about computers in general, also had quite deeply-rooted worries or criticisms about computers and were concerned with the possible abuse of power which might arise as a result of the use of computers in society. Could this, as some of the comments by teachers reflected, be due to the perceived capabilities of computers in storing and accessing large quantities of personal data ? Some of Wayth's (1981) sample of seven teachers, for example, were apprehensive due to a lack of understanding as to the capabilities and uses of the computer. In Barnaby Comprehensive, some of the teachers also had feelings of inadequacy arising out of an ignorance of computers or the terminology used to describe computers. Others, however, were fascinated, impressed and interested about the capabilities of computers, seeing computers as an important and useful tool and a growing influence in education. It seems that for some teachers, the capabilities and "power" of the computers could be awe inspiring leading to a fascination with computers, while others felt very much threatened by them.

This range of views about computers was narrower when it came to analysing the perceptions teachers held about computers in teaching. Stevens (1980) for example, found that over 46% of his sample of teachers were undecided or did not believe computers would enhance learning. Also, all of the teachers in Barnaby Comprehensive had reservations about the use of computers when it came to using them in their teaching because of genuine worries or criticisms about how computers could be used. As numbers in the study were small, it was not possible, in contrast to Beck (1979), to see any clear pattern in the perceptions of male and female teachers towards the use of computers. However, both male and female teachers exhibited a wide range of opinions.

When the teachers' perceptions about computers in teaching were examined more closely, this revealed a number of worries at different levels. It became clear, for example, that the teachers at Barnaby Comprehensive perceived changes in their role as one of the critical issues with the onset of the use of computers. Teachers in the five departments in Barnaby Comprehensive perceived that there would be changes in themselves as an authority (i.e. being competent), changes in themselves being in authority (i.e. being in control and confident in the classroom), and changes in their teaching situation. Such issues were mentioned by Anderson et al (1979), Elder et al (1982), the ITMA team (Fraser et al, 1983; Phillips et al, 1983; and Ridgway et al, 1983), and Sheingold et al (1983) who highlighted the fact that teachers were concerned with how they would manage the use of computers in the classroom.

Teachers perceived that the use of computers would require them to be seen as an expert in the use of computers and that they would need to acquire expertise in a new and unfamiliar field in which, it might be added, some pupils were already proficient. One of the conclusions made by Elder et al (1982) was that teachers felt that the amount of competence required to use the computer was minimal, but that the real issue was acquiring the necessary confidence. At Barnaby Comprehensive, the teachers seemed to express more of an interaction between the issue of confidence and competence, with many of them expressing a lack of self-confidence as revealed through their own comments about themselves (i.e. how they saw themselves, their self-concept), and/or comparing themselves with their pupils, together with the need to acquire the necessary knowledge and skills. Hence, as Anderson et al (1979), Stevens (1980) and Sheingold et al (1983) had found, adequate

training prior to use was an important element. More importantly however, at Barnaby Comprehensive, this was not sufficient. Quite often, issues of being in authority were disguised by the teachers, and so many teachers had put forward, for example, the problems of computers being damaged, broken or stolen. It became clear that such comments were expressing an anxiety about classroom control and management, and the role that pupils would see the teacher as having in classes where computers were being used. Such feelings of "not being in charge" together with earlier feelings of "not knowing about computers", combined with feelings of "not being logical or mathematical" created in many of the teachers at Barnaby Comprehensive a real apprehension about using computers. In this study, teachers could be seen to be asking for help at a number of levels, including the very basic but essential skills of classroom management and control when using computers. Another issue which both Elder et al and this study found was that teachers were more concerned about the security and safety of the computers, without mentioning the safety of their pupils who were using equipment that might be electrically dangerous.

Another pattern that emerged was that the majority of those teachers who talked about their problems with teaching (even when not using computers), were also concerned with such issues as classroom management when computers were to be introduced. They were the same teachers who expressed their struggles and difficulties concerning their job or admitted that they were "traditional" in their way of teaching, and were also worried that pupils might damage the computers. In addition, they were worried as to how they would be able to change or adapt their way of teaching if they had to incorporate the use of computers.

A further relationship that could be seen was that those teachers who expressed fears that their traditional roles (for example, as an imparter of knowledge) might be challenged, also expressed the fear that this change of roles might necessitate changes in the composition and size of the classes. This would, in turn, require a change in the amount of computer facilities and technical back-up required and, it could be speculated, ultimately lead to a change in the organisation of the school. This was also reflected in the studies by Alderman and Mahler (1976) who found that although teachers at the tertiary level said that they were open to innovation they wanted to preserve their autonomy in any curriculum decisions or in establishing and testing their own instruction, i.e. they were afraid that their

traditional roles would be challenged. The research carried out by the ITMA team (Phillips et al, 1983; Ridgway et al, 1983; Fraser et al, 1983) largely recognised the fact that teachers' roles in the classroom would change and thus explored the various ways in which these different roles and methods of teaching could affect the activity and learning processes in the classroom. The teachers who were asked to participate in the ITMA studies were enthusiastic teachers, or at least teachers who were prepared to attempt these various teaching styles.

4.3 Departments and Computers

This research study attempts to stress the fact that while it is crucial to understand the different viewpoints of teachers, it is necessary to realise that teachers are within the organisational setting of a school, and that schools have heads of department who are decision and policy makers and who, either directly or indirectly, affect the implementation of an innovation within a school (i.e what Lundgren terms as the The Formal-Rule System).

Sheingold et al's (1983) study showed (and mentioned in passing by Anderson et al, 1979; and Pengov, 1977) that it was necessary to go beyond the personal perceptions of teachers, about themselves and the use of computers, to consider the organisational constraints or solutions (i.e. the Frame System), that teachers perceived when using computers. In addition, most of the research studies conducted so far (especially the questionnaire/survey types of Alderman and Mahler, 1976; Anderson et al, 1979; Bolton and Mosow, 1981; Pengov, 1977; Robardey, 1971; Stevens, 1980; and Stimmel et al, 1981) looked at the teachers' attitudes either at one particular point in time or over a short period of time (before and after a CAI lesson). An important issue that was addressed in this research study was whether attitudes of teachers and/or leadership styles of heads of departments at Barnaby Comprehensive changed during the course of time.

4.3.1 Department Organisational Constraints and Solutions

The individual comments of teachers were summarised in Figures 9 and 10, and include organisational constraints in the following areas :

1. **Class Size and Level** - Teachers mentioned that they would have preferred to start using computers at the 6th form level as they consisted of smaller class sizes. They said they also believed that the pupils in the 6th form generally responded more readily, and that there were more difficult concepts to be taught in the 6th form level which they perceived could be handled by the use of a computer. On the other hand, some teachers saw the use of computers for 6th formers only as very limited.

2. **Resources** - Teachers remarked that they perceived that there were insufficient facilities provided for the use of computers. They commented that to have one computer in the department was only good to play with but useless for teaching, and felt that it would be seen as a toy and not relevant to any important work. They suggested having a batch of computers available within each department so that they could be used whenever needed, just like calculators.

3. **Time** - This was an overwhelming constraint perceived by the majority of teachers in all the departments. This mainly had to do with time for training, teaching and the development of software.

Teachers stated they felt frustrated that there was a lack of time to find out more about computers and to see how they could be used in the classroom. Teachers mentioned that time was needed for them to know and to acquire the skills necessary to use the computers, and that there was no time provided for training, although there was a willingness to attend such training courses.

Teachers also commented that there was no time because of the varying pressure of work and responsibilites. They said they also believed that more time would be taken up in preparation to use computers than actually using them. Thus teachers said that they felt that there was a continuous tension between having sufficient time for their administrative responsibilities, for teaching and for using computers. One teacher commented that the provision of only three free periods a week was "ludicrous" as it did not give them the time to execute any other responsibilities. Some teachers also highlighted the fact that there was no time given or timetabled to help and advise other members of staff in the use of computers.

S/NO TEACHER	STRATEGIES	REACTIONS	CLASS SIZE & LEVEL	TIME	RESOURCES
SCIENCE DEPARTMENT					
1. June			* Groups not small enough. * Start with 6th form because easier to, they respond, and smaller class size.	* Unsure how portable comps. are and how that would affect use.	* Insufficient facilities. * Initial frustration because room where comp. was in was cold and no power point.
2. Mikado					* Able to use comp. room because his class is next to it, and he is in good terms with Mr. Bohr.
3. Bohr	〃				
4. Case (Head)	* Introduce in a "quiet" way. * Pilot study with one class. * A back-up to 6th form lessons. * Would like to know more about potential of comps. so that he would feel more certain when allocating finance. * Dept. should provide expertise - advise, help & try. * Aware that he should not be seen "hogging" the comp.		* Starting with 6th form as more difficult science concepts at this level.		
HISTORY DEPARTMENT					
5. Joachim		* No prior discussion - not democratic and antagonism caused. * Head of dept. is logical but likes bandwagon and will use comps. because he only teaches top grps. * Should first obtain dept. commitment.			
6. Ridley		* Negative effect if dept. heads jump on "comp. bandwagon". * No prior consultation made. * Dept. head was doing PhD work which reqd. comp.			
7. Malory		* Only heard about purchase of comp. through the "grapevine". * Teachers went along orientation course as each dept. wanted to be seen to be involved.			
8. Johnson (Head)	* Fully aware that money used could have been spent on books to keep teachers happy. * Look for appropriate software and draft proposals. * Introduce a pilot scheme for 3rd years. * Encourage staff.				

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S/NO TEACHER	STRATEGIES	REACTIONS	CLASS SIZE & LEVEL	TIME	RESOURCES
GEOGRAPHY DEPARTMENT					
9. Constance		* Too much emphasis placed on whether dept. has got a comp. * Traditional teachers in department. (If dept. is "go-ahead", it would be natural for depts. to use computers.			
10. Hugo		* Too much money spent on comps.	* Used in a limited way because only for 6th form.		
11. Coleridge (Head)	*Start with in-service course. * Demonstrate practical uses. *Short term - simul. Medium - wordpro. Long term - admin.		* Pupils not literate in using computers. (Pupils to work in small groups with a computer-literate pupil). * Disruptive pupils. (One pupil per comp at a time).		
MATHEMATICS DEPARTMENT					
12. Joule		* Dept.'s present priority should be on improving limited resources because of financial restrictions. * No teacher was willing to prepare material or courseware for computer literacy course.		* Only one comp per dept. is "good to play with but useless for teaching". (A batch of comps. within each dept., just like calculators would be useful).	
13. Jackson		* Did not take offence when head of dept. did not consult staff before purchasing computers.			
14. Sully	RN				
15. Novelis (Head)	*Start with comp. awareness course for 3rd years. *For admin. eg. production of exam. papers and assessment.				
BUSINESS STUDIES DEPARTMENT					
16. Rubens (Head)	*No specific strategy but allowed staff to pursue their own comp. interest.		*Only used for 6th form as class size for them is small.		

DEPARTMENTS AND COMPUTERS (TIME) :

S/NO TEACHER	TRAINING	TEACHING	DEV. SOFTWARE	OTHERS	PRIORITY
SCIENCE DEPARTMENT					
1. June	* Frustrated because of the lack of time to find out more about comps. and how they can be used in the classroom.	* Varying pressure of work.			
2. Mikado		* No time due to pressure of work and responsibilites.	* No time to develop suitable software.	* No time to help other staff in comps.	
3. Bohr				* No time timetabled to discharge his responsibilities to advice indv. teachers.	
4. Cano (Head)	* No time to develop his own knowledge and experience in using computers. * Being more efficient may "create" time.	* More time in summer term when national exams. are over.	* Software should be purchased rather than written by inexperd. teachers.		* Time is the critical factor. * Does not "make time" because comps. are not his first priority.
HISTORY DEPARTMENT					
5. Joachim		* Only 3 free periods a week is "ludicrous". * Create time by team-teaching (more difficult in lower school).			* Time is a cost factor. * List of priorities is dictated by exams.
6. Ridley	* Time needed to acquire skills to use comp.	* Continuous tension between teaching & careers work.			* Priority to use comps. not high enough.
7. Malory	* No time for training though prepared to attend courses.	* No time because of administrative responsibilities.			* Feels that it is the Headteacher's job to ensure that time is available for staff to undertake necessary trg.; to make sure that curriculum offers the use of comps.; to make the necessary adaptations to buildings to use computers. Teachers may then be prepared to give time.
8. Johnson (Head)	* Time needed for teachers to learn how to use comps.		* Time needed for teachers to look carefully at software to see whether it is appropriate. * Time needed for individuals and orgs. to produce and disseminate info. and skills.		

S/NO TEACHER	TRAINING	TEACHING	DEV. SOFTWARE	OTHERS	PRIORITY
GEOGRAPHY DEPARTMENT					
9. Constance	* No time to attend lunchtime orientation courses.	* Continuous tension of wanting to keep lunchtimes free.			
10. Hugo		* Would use only if information is available at moment's notice. * More time taken up in preparation than in using comp.			
11. Coleridge (Head)			* No time to develop relevant software and so uses comp. less than what he wants.		
MATHEMATICS DEPARTMENT					
12. Joule	* To become familiar with comps.	* Normal teaching workload is heavy (Use comps at summer term because pressure of work is less then).			* Priority is low.
13. Jackson	* Learning to use comps. to teach maths. takes a lot of time which she cannot afford.	* Would use comp. during "easy-spell" ie. at end of term.			
14. Sully	NK				
15. Novalis (Head)	NK				
BUSINESS STUDIES DEPARTMENT					
16. Rubens (Head)	*Unable to attend orientation course because of other lunchtime responsibilities.				

Then there was the time mentioned by teachers that was needed for them to carefully look at software to see whether these software were appropriate. Some teachers also realised that software should be purchased rather than written by in-experienced teachers as they would take to much time to do so because of their lack of experience.

Teachers recognised that the use of computers was low in their priorities and thus did not "make time" to use computers. They said they realised that the time allotted for the use of computers was a matter of priorities which for one of them, for example, was not high enough a priority, and for another, was dictated by examinations.

Teachers said they felt that they would be prepared to use computers if the Headteacher ensured that time was available for staff to undertake the necessary training, made sure that the curriculum offered the use of computers, and made the necessary adaptations to school buildings so that computers could be used. Teachers felt that there might be more time available in the summer term when the state examinations were over and when the pressure of work was less.

4.3.2 Leadership Styles

This is analysed over a period of one and a half years as it was necessary to see which factors, or combination of factors, were more dominant in the eventual takeup or non-takeup of computers within the school. Even within a single school, the five departments exhibited different styles of leadership, with the Science and Business Studies departments revealing a democratic leadership style, the History and Mathematics departments an autocratic style, and the Geography department with a laissez-faire style of leadership.

At the outset, it might have been hypothesised that a democratic as opposed to an autocratic leadership style might lead to a greater uptake of computers. Two departments, the History and Science departments, could be contrasted in this respect. The Science department had a democratic style of leadership which was thus hypothesised to lead to more cooperation between teachers and

head of department, and so after one and a half years, the Science department might have made rapid progress. At Barnaby Comprehensive, the teachers in the Science department had the most favourable attitudes towards the use of computers although with reservations. In addition, the head of department's strategy was for encouraging teachers in the department to use computers. This contrasted with the leadership style of the History department which was an autocratic style, and it might be expected that the antagonism experienced by the teachers as a result of this style would lead to a rejection of the use of computers in the department. There was also a mixture of favourable and unfavourable attitudes towards computers by teachers in the History department.

In both departments, teachers saw organisational constraints hindering the use of computers in their teaching. For the Science department, there was a major force against computer use as a result of department organisational constraints of time, resources and class size and level, and for the History department, the main organisational constraint was that of time. Both these departments saw the constraint of time for training and using computers as a common factor which could only be solved at the organisational level of the school.

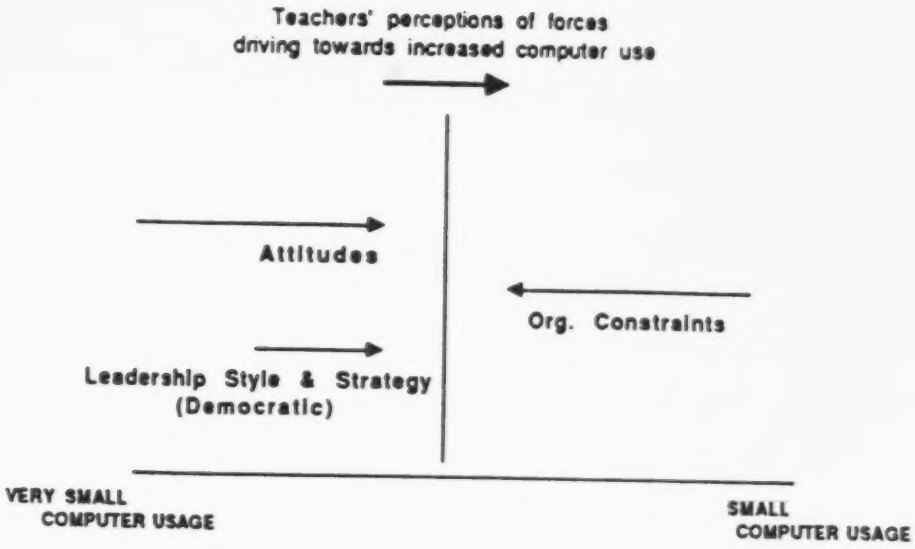
When these two departments were compared one and a half years later, the actual uptake of computers was different from that initially envisaged (Figures 11 and 12). There was a relatively larger increase in the use of computers in the History department than in the Science department, over the one and a half years. This could be interpreted as the result of the dominant role of the head of department which gradually turned to a more democratic style of leadership, who through this means took the burden of decision-making in an area unknown to his staff. Thus the autocratic leadership style served as a positive force when needed, inspite of opposition. This style of leadership switched to a democratic leadership style. For example, teachers felt that their head of department was informing them more of his ideas about the use of computers in the department which thus provided a continued positive force towards the use of computers in that department. This is compared to the Science department which, although starting with an extremely positive attitude system and a department head who initially had a favourable policy towards the use of computers, had a smaller uptake of computers. This could be because the head of Science did not feel that he should be taking a leading role in the use of computers and so there was no real follow-up strategy or

subsequent department policy to get individual teachers "off the ground". As a result, teachers in the Science department were left to themselves to do as much or as little as they could in using computers.

It might be hypothesised that the attitude system would be all important in determining the uptake of computers, and this may be the case in the short term. However it would seem that for the long term, additional positive forces such as "strong leadership" (i.e. the formal-rule system) are more important determinants. So, for example, the History department provided a model of how the dominant leadership style and strategy of the department head could play a part in the introduction of computers to a department. Two major changes of forces had occurred over the one and a half year period in the History department. Firstly, there was a change of attitudes by all three teachers. A reason for this change of attitudes could be the fact that the strong leadership style of the head of department "directed" the teachers to consider the use of computers. Once they saw how computers could help them, especially in administration, their attitudes gradually altered. The other major change was that the leadership style of the head of department had also altered to a more democratic style, informing and encouraging teachers in the use of the department computer (which they now, after one and a half years, perceived as easily accessible). This change of leadership style was seen to be necessary if sustained computer uptake was to take place in the department. It could also be hypothesised that this change of leadership style was necessary so that the earlier feelings of antagonism experienced by the teachers as a result of the initial autocratic leadership style of the head of department would not become a continued and major force against the use of computers within the department in the long term.

The Science department, on the other hand, provided a model whereby the sustained positive attitudes of teachers led to an initial uptake of computers, inspite of organisational discouragements (the frame system), but that this uptake of computers drastically slowed down or even stopped without a strong department policy to provide guidance and encouragement for the further use of computers. The uptake of computers was small and this was despite the fact that after one and a half years, the teachers were still positive towards the use of computers in teaching and that they were now aware of new organisational solutions regarding the availability and accessibility of the department's computer.

Baseline :



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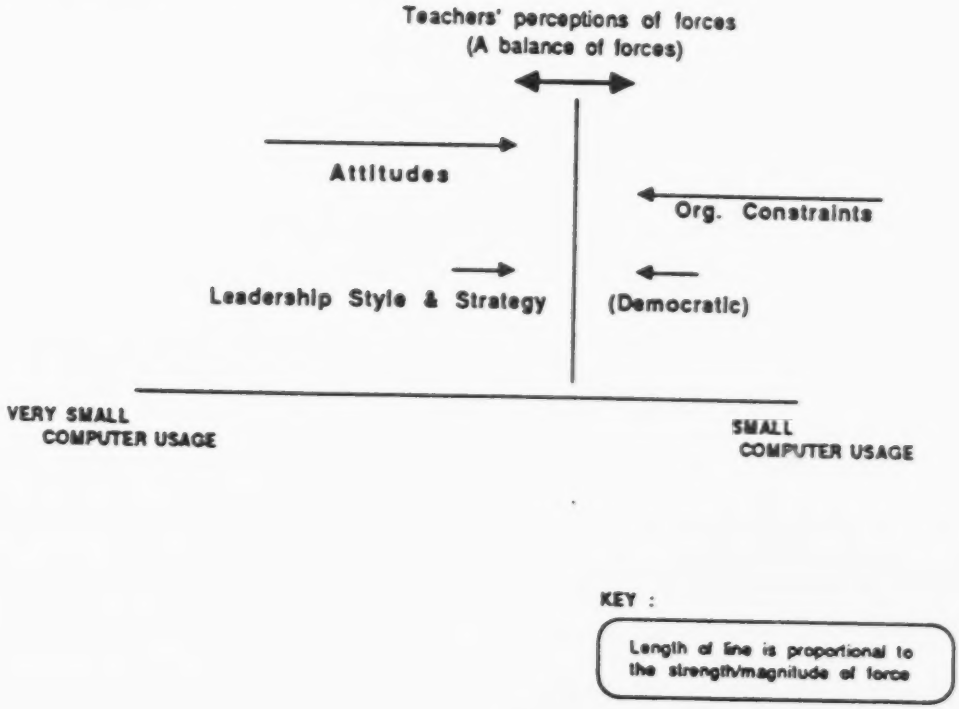
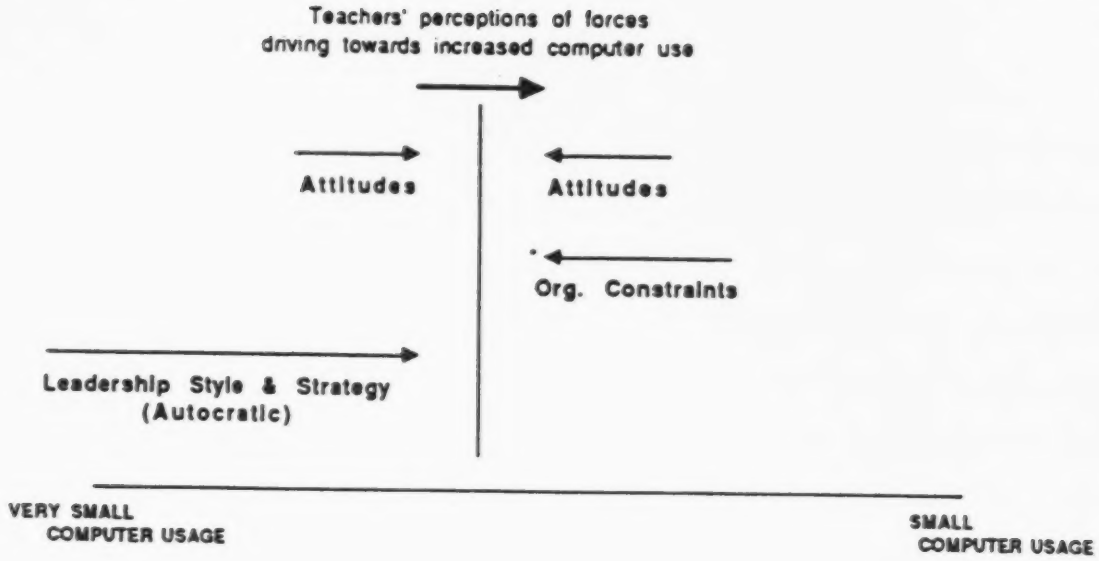


Figure 11 Force Field diagrams for the Science Department over the one and a half year interval.

Baseline :



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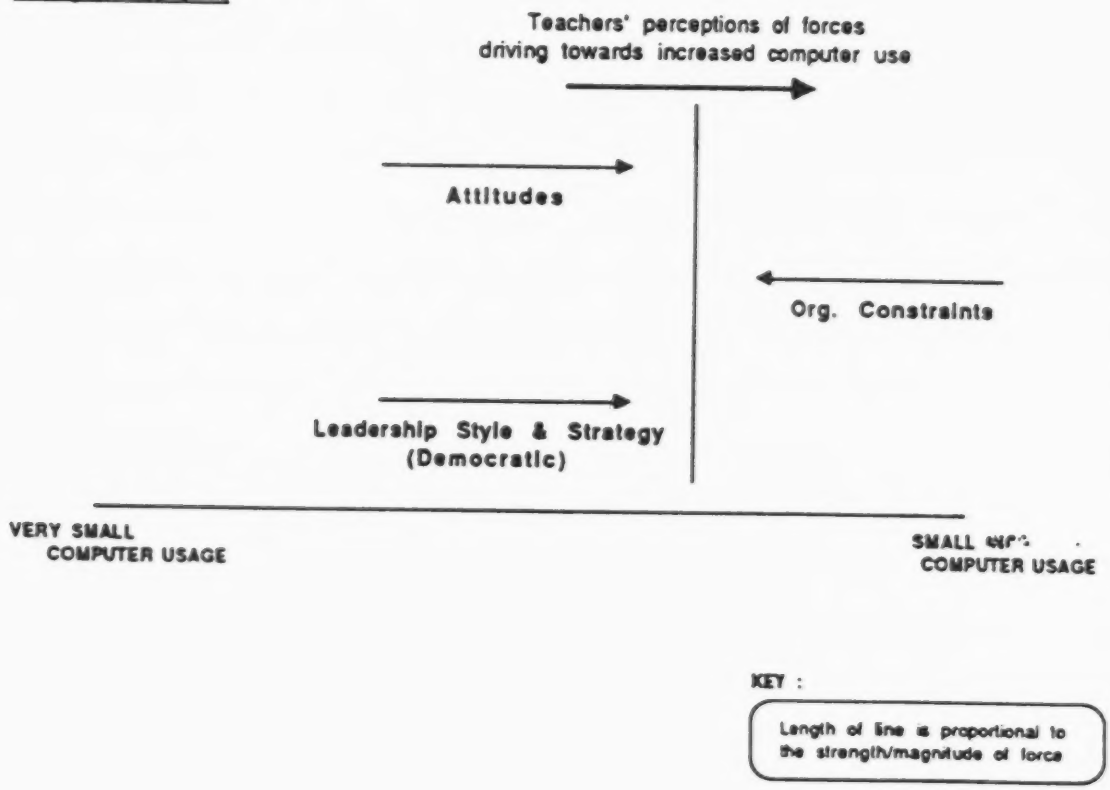
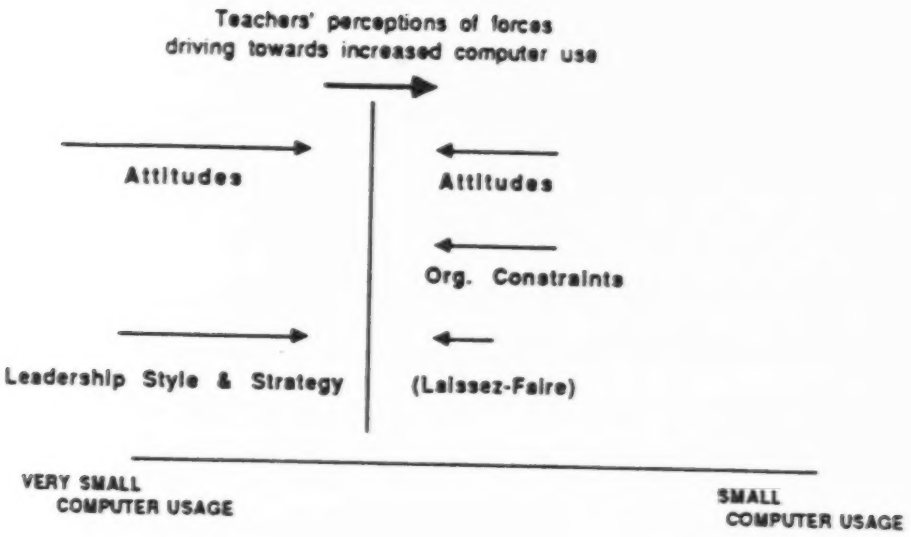


Figure 12 Force Field diagrams for the History Department over the one and a half year interval.

Turning now to the Geography department, which in many ways did not resemble the other two departments just discussed, it might be hypothesised that the uptake of computers in this department would be minimal since there was neither a strong leadership style nor a positive attitude system. The Geography department provided a situation where there were the various conflicting forces of the attitude, frame and formal-rule systems within a single department (Figure 13). As in the History department, there was a mixture of both positive and negative views towards computers by teachers, although in the Geography department, the positive attitudes were more dominant. There was also the negative frame system (which in this department was the main organisational constraints of time and class size and level) which provided another force against the uptake of computers. The lassiez-faire leadership style of the department head meant that the pattern of innovation diffusion was unsystematic and unplanned. So while the leadership style might be seen to be neutral, it seemed to be positive because, it could be hypothesised, that the help and guidance provided by the head of department, which if accepted, became a positive force which altered teachers' attitudes towards using computers. This in fact compelled the department into a fairly substantial uptake of computers (comparable to that of the History department). For example, one of the most dramatic changes was by a teacher in the Geography department who was initially antagonistic towards the use of computers but whose attitudes radically changed in the area of the use of computers in administration as a result of the help provided by the enthusiastic head of department. So in this department, these keen and enthusiastic teachers who made themselves available to help others at any time and to build the confidence of others in the use of computers at the expense of their own personal time and energies, played a very important role. This was similar to the findings of both Sheingold et al (1983) in their analysis of their third educational authority and of Pengov (1977), who found that the involvement of potential adopters was greatly affected by the enthusiasm of keen teachers.

The leadership style of the head of department could perhaps be reinterpreted in the long term as looking more like a democratic style of leadership, given that he was always around, available and cooperative, allowing teachers the freedom to choose. This positive formal-rule system also led to a change in the frame system as teachers felt that the department was now trying to put in additional resources, for example additional finance, to encourage and help in the use of computers.

Baseline :



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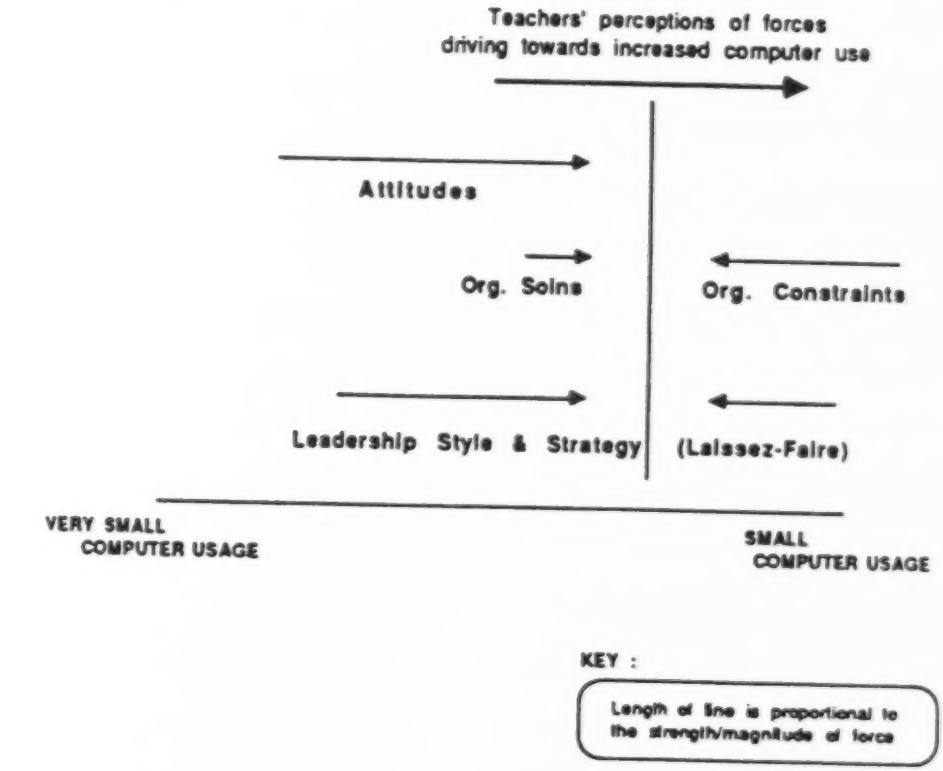
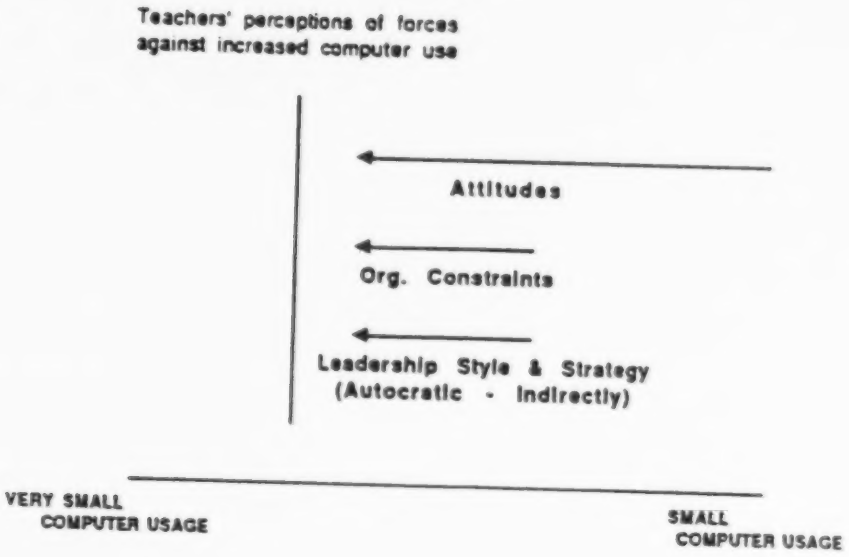


Figure 13 Force Field diagrams for the Geography Department over the one and a half year interval.

The Mathematics department was comparable to the History department in as much as it had a similar formal-rule system (i.e. an autocratic style of leadership) and frame system against the use of computers (Figure 14). Teachers in the Mathematics department perceived the lack of time and insufficient resources as the main organisational constraints. Computers were not regarded as one of their main priorities. In addition, the head of Mathematics did not inform his staff members of his intentions and plans for the use of the BBC computer in the department. Teachers said they regretted that guidance from their department head was not forthcoming. Finally, the attitude system of the teachers in the Mathematics department was very negative as teachers were either unfavourable or antagonistic towards the use of computers, or were completely unaware of the potential uses of computers in teaching. In this instance however, the autocratic leadership style was not a force towards the uptake of computers (as was the case in the History department) and the negative attitude system and frame system thus led to no real uptake of computers at the beginning.

It might be predicted that in the Mathematics department there would not be any uptake of computers, even after one and a half years. This was not the case however as there appeared to have been a subtle and stronger force intervening in the Mathematics department during that period. This intervening force, it could be hypothesised, was that mathematics teachers became aware that they needed to be seen by society to be knowledeagble in the use of computers, i.e. they became concerned about their self-image. Present-day teachers of mathematics felt that modern mathematicians should be using computers in their teaching and that it was only the old-fashioned ones that did not use them in the classroom. This was reflected by the Mathematics teachers' comments that they believed that society would require their pupils to know about computers which thus required them as Mathematics teachers to be able to fulfill that role. This subtle force thus brought about a slight increase in the uptake of computers one and a half years later. This was mainly as a result of individual teachers in the department, and not as a result of the leadership style or policy decisions of the head of department (as was the case in the History department), or the keeness of the head of department (as was the case in the Geography department).

Baseline :



1.5 yrs. Later :

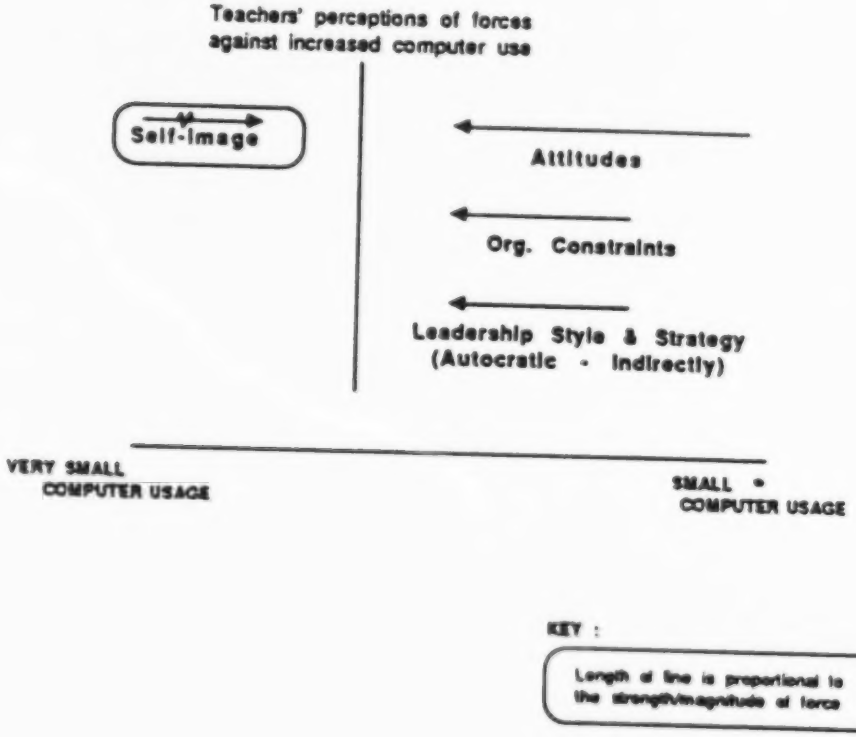


Figure 14 **Force Field diagrams for the Mathematics Department over the one and a half year interval.**

Very little can be said about the Business Studies as a departmental organisation because only one person was interviewed. However, the comments and experience of that teacher provide an additional insight into the use of computers in the department and school (Figure 15). The head of department himself admitted that he was not competent with computers and so his positive democratic leadership style and attitudes were obstructed by this lack of computer knowledge, which resulted in a lack of clear policies and strategy for the implementation of computers within the department. This, together with the negative force of the frame system in the Business Studies department (i.e. the perceived organisational constraints, especially of unexpected costs) led to no real uptake of computers in the department. Even with positive attitudes, there could be no real progress in the use of computers in the department if there was no clear strategy to provide a force strong enough to overcome the organisational constraints in using computers in the department.

4.3.3 Relationship between Leadership Styles, Organisational Constraints and Attitudes

Lastly, concerning the inter-relationship between the frame system (organisational constraints and solutions) and the other two systems, it could be seen that the frame system had an important effect on teachers' attitudes. For example, the organisational factor of time played an important role both at the beginning and during the whole period of the study for all the teachers in the departments. Time, while looking like a simple organisational constraint, could be hypothesised to play a much more crucial role. Teachers who had a negative self-image of themselves or felt incompetent in using computers saw time as very necessary to acquire the necessary knowledge and skills to use computers in a classroom situation. They needed time to be trained in the use of computers, time to use computers in their teaching itself, and for some, time to look at software or to develop suitable software for their own use.

Another major organisational constraint which was reinforced during the one and a half years was the teachers' perceptions of resources and finance available for the use of computers. Teachers initially felt, for example, that there were not enough computers available to encourage them to use computers more frequently. With the passage of time, teachers began to realise not only the insufficient number of computers available, but also the limitations of equipment that they had and the

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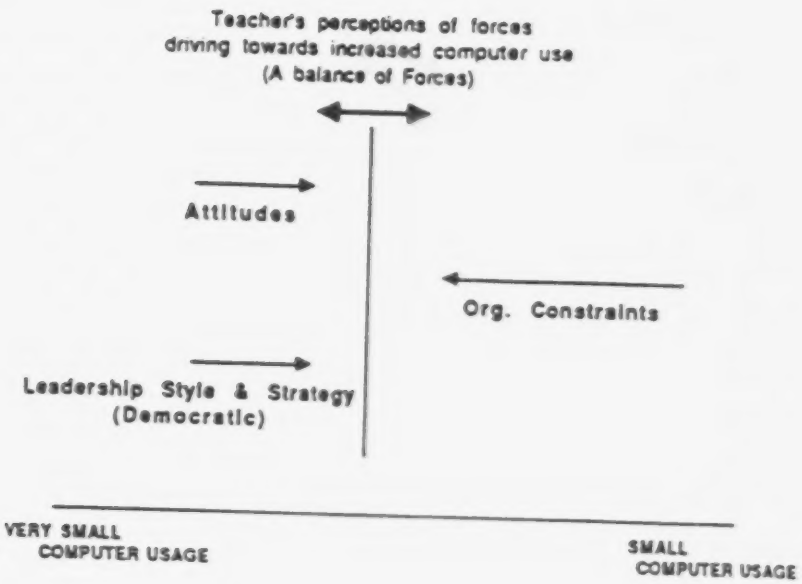

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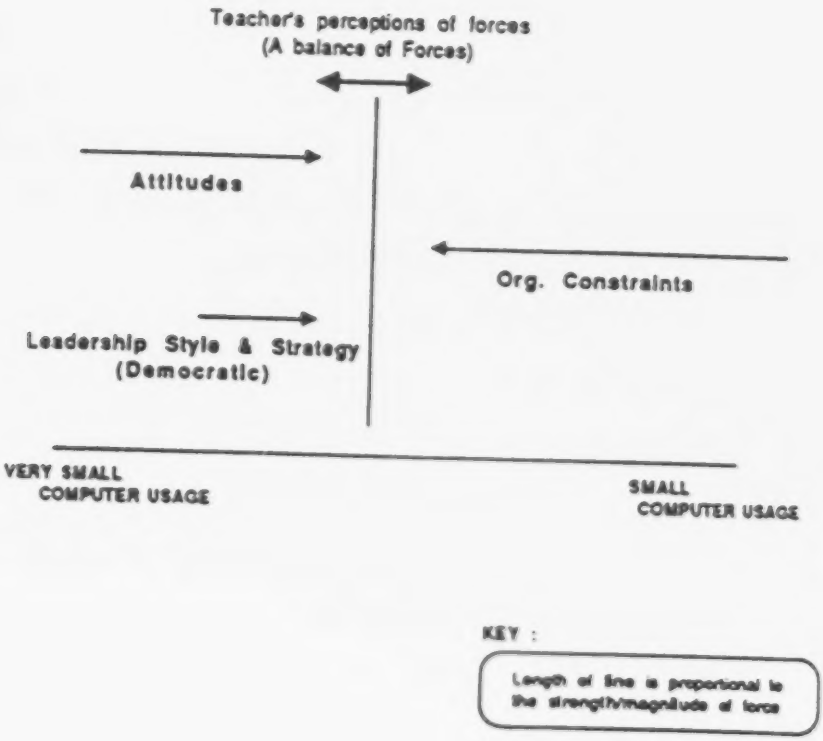

Figure 15 Force Field diagrams for the Business Studies Department (perception of one teacher) over the one and a half year interval.

need for additional resources if they were to achieve their intended use of computers. For example, teachers in Barnaby Comprehensive soon realised that extra computer memory and extra money (for the purchase of disc drives or printers) was needed which had not been budgeted for. They felt that this was due to a lack of foresight on their part for not requesting sufficient finance in the first instance. There was also the new realisation that as progress was slow, there would be the possibility of the computer systems they were using becoming rapidly obsolete. Initially, these resources were not acknowledged by the teachers simply because, it could be hypothesised, there was not enough computer awareness by teachers at the beginning. As their awareness of the use of computers grew, even though it was still very limited, their awareness of the lack of resources grew.

So it would look as though the attitude system interacts fairly significantly with the frame system as organisational constraints provide the boundaries wherein teachers develop their ideas, or change their attitudes about the use of computers in teaching. For example, due to the lack of time and resources, teachers are unable to explore the different uses of the computer and to formulate views and opinions as to how computers could be used and managed in their classroom situations.

4.4 The School and Computers

Just as it was crucial to look at the three systems (attitude, frame and formal-rule) of the various departments, and to see the effects that they have on the actual use of computers one and a half years later, it is equally important to look at these systems at the level of the school. Thus the systems examined at this level were the School Frame System (i.e. the organisational constraints and solutions at the school level), and the School Formal-Rule System (i.e. the leadership style and strategy of the Headteacher, and the reactions of the teachers to his style and strategy). In addition, the Goal System (i.e. the Curriculum) and the Frame System at the education system level is reflected in this discussion here as they impinge on the innovation of computers at the level of the school. These factors are not the only factors at the educational system level, but these were the factors perceived by the teachers as directly affecting their use of computers in the school. The comments of the teachers at these two levels are summarised in Figures 16 and 17.

THE SCHOOL AND COMPUTERS

S/No Teacher	Reactions	Training	Finance/Resources	Hardware/Software	Class Size & Level	Timetable	Curriculum
SCIENCE DEPARTMENT							
1. Case (Head)	• Implementation of comps. in school is very much dependant on Headteacher. • Headteacher may put in money if there are keen teachers and if Headteacher is aware of potential of computers.		• Ensure of requirements needed for a comp. room. • Having sufficient finance to provide comps. for every teacher & pupil who wanted to use them.	• Security of comp. would a problem.			• Pupils may get too much of the same thing in one day. • Different depts should coord to reduce excessive exposure to comps.
2. June	• Worried that Mr. Bohr was given double responsibilities without more time to discharge it. • Comp. Studies should be a separate dept.	• Needed guidance when learning to use comp. • Found orientate course helpful but one hour a week is not sufficient (Prefer a 3-day course in programming and evaluation/ testing of software. • Feels that being a Biology teacher, it is difficult to justify going on a computer course.				• Booking a comp. as easy as booking a film projector	
3. Mikado	• Effort put in by staff has had effect on use of comps. • Depts should be convinced that it is worth spending money on comp. equipment & resources.			• Once staff are convinced to use comps., there would be insufficient comps. - a viscious cycle.		• As more teachers want to use comps., there would be a clash of timetables. (Timetabling can be solved by internal organisation).	
4. Bohr	• Frustration of being expected to do two jobs at one time - unfair on staff & pupils. • Insufficient direction from the top w.r.t. financial policy. Thus depts. developed comp. resource indpdly. and so resources are diluted.		• Problem of power cuts.	• Danger of theft. • Insufficient computers. • Inability to obtain and evaluate software before purchasing. • Linking in with networks eg. Micronet, may solve software prob.			
HISTORY DEPARTMENT							
5. Johnson (Head)	• Bemused by how much work is done on goodwill	• Need to provide actual opportunities to use comps. and to apply to individual & dept. • Good but not sufficient to org. demos.				• Soc. scis. not suitable for use of comps. bec. constant changeover of pupils & classes.	
6. Joachim	• Develop line from top that comps are "the greatest thing".	• Provide in-service trg. and confs.	• School should provide support in terms of available facilities.				

S/He Teacher	Reactions	Training	Finance/Resources	Hardware/Software	Class Size & Level	Timetable	Curriculum
7. Ridley	• Unhappy that due credit has not been given to Mr. Bohr. • Comps. should be under the control of comp. teacher and one or two colleagues who know about comps. and have access to suitable progrms. • Heads of depts. must first justify purchase of comps. • School office should be encouraged to use comps for admin.						
8. Malory	• Should not expect comp. teacher to mend machines and teach at the same time.	• A trial to be done to discover the likely problems & prep. needed. • On-going staff trg. prog. should be a priority - regularly and for diff. levels.	• Physical difficulties of moving class or computer. • Insufficient classroom space & desks, let alone, comps. • Impt. to have comp. teacher to be backed up by technical staff.				
GEOGRAPHY DEPARTMENT							
9. Coleridge (Head)	• Priority of teachers to use comps. is not high enough.	• In-service trg. essential and to be taken by keen teachers. • Org. different events which demonstrates different uses and applications of computers.	Purchasing network would be in compt. to other school needs like purchase of new school minibus.	• There will always be the problem of insufficient computers (Having a comp. room only temporarily solves this problem). •Long loading time (Network system would help). • Physical problem of setting-up the comp. equipment.			
10. Constance	• Decision to purchase comps. was made by people who did not know about individual workings of dept. and effectiveness of decision. • Purchase of books should be a higher priority than comps. • Against the thinking that the school's reputation is dependent on number of comps it has. • School policy concentrates too much on brighter pupils and neglects the average and dull pupils.						•Syllabus dictates whether comp. is useful tool or not.

Figure 16 (contd.)

S/No Teacher	Reactions	Training	Finance/Resources	Hardware/Software	Class Size & Level	Timetable	Curriculum
11. Hugo	* Too much money spent on comps. and so money for much needed basic textbooks.				* Used in a very limited way - only for 6th		
MATHEMATICS DEPARTMENT							
13. Joule	* School has neglected lower-ability pupils as there is no special scheme for them to use comps.						*Exams. limit syllabus. *Not flexible enough. *Comps. not a priority bec. not integral part of course.
3. Jackson		* Need to use part of school's IST to provide information & awareness of the uses of comps. for each subject and not just comp. programming.		* Need a lot more comps. if going to use frequently in lessons for various subjects.			
14. Sully		* Little incentive to resume lunchtime course even though it was beneficial (as there was people to guide). * Prefer a week-long computer orientation course. * Difficult to attend course outside of school as finance is limited and one needs to be nominated.					
BUSINESS STUDIES DEPARTMENT							
15. Rubens (Head)			* Problem of finding suitable & safe place. * Problem of finance to buy computer. * Hassle to take comp. in & out of cupboard.		* Large class numbers a problem in lower school.	* Problem of arranging suitable timetables so that comp will be avail.	*Struggle to cover entire syllabus esp. *A* levels.

Figure 16(contd.)

TEACHERS' ORGANISATIONAL CONSTRAINTS AND SOLUTIONS (EDUCATIONAL LEVEL)

S/No Teacher	Software	Finance	Expertise/Trg
SCIENCE DEPARTMENT			
1. Case (Head)	• Sc. depts from various schools in an area should get together to exchange info.		
2. Jane		• Finance, class sizes & comps are inter-related and outside of purview of school.	
3. Mikado			• Ed. Authorities should provide : - Extra trg for staff. - Finances for courses. - A supply of teachers to replace those on course. - Time for in-service training. • Proper trg. of teachers "impossible" because of ed. spending cuts. • Most courses held in evenings and teachers are thus unable to attend.
4. Bohr			
HISTORY DEPARTMENT			
5. Johnson (Head)	• Transfer of info. should be looked into • Comp. experts, experienced teachers, representatives from exam. boards and journalists should combine effort to develop software. • Software info. should be made freely available to teachers, not in comp. magazines but in subject-related periodicals.	• Not sufficient finance to back-up govt.'s introduction of comps in schools. • Govt.'s scheme - "whitewash idea".	• Experts should be called to help schs. • Expertise should be obtained not via one-day confs. but through progs. & workshops at teachers' centres with "hands-on" experience.
6. Joachim	NR		
7. Ridley		• LEAs should provide the finance to join networks as cost is prohibitive for individual schools.	• Intro. of comps. should be done with careful planning, prior research and should be "marketed".
8. Malory		• Unfair for PA to fund purchase of comps. because schools in poorest areas would never have the chance. • County should impress on DES that they should provide all the funds for introducing comps.	• Local advisory staff in County should make themselves aware of comp. problems in schools. • County should make available to their Inspectorate any expertise needed.

Figure 17

S/No	Teacher	Software	Finance	Expertise/Trg
GEOGRAPHY DEPARTMENT				
9.	Coleridge (Head)	* No real development of software by schs. * Poor publicity & communication betw schools and software houses. * LEA should belong to central software development orgs. & provide publicity for suitable machines and software. * Groups in teacher centres, or univ. and colleges should test software and provide guidelines similar to exam syllabus; & also produce software by providing programmers to work with teachers.		
10.	Constance	NK		
11.	Hugo	NK		
MATHEMATICS DEPARTMENT				
12.	Joule			* Should be more than a 2 or 3-day course.
13.	Jackson	NK		
14.	Sully	NK		
BUSINESS STUDIES DEPARTMENT				
15.	Rubens (Head)	* Commercially available software are too expensive. * Economics teachers should get together to exchange ideas and software they have written.		

Figure 17 (contd.)

At Barnaby Comprehensive, the leadership style of the Headteacher was seen to provide a major force towards the uptake of computers in the school (Figure 18). Teachers perceived the leadership style of the Headteacher to be democratic and thus helpful in the introduction of computers, although some felt that there was still insufficient direction given with respect to an overall policy. Some of the headteacher's strategies that were seen to be positive steps towards encouraging the use of computers in the school included the financial provision (50% subsidy) for the purchase of computers, and the formation of the Computer Studies department. Organisational constraints, however, were considered by teachers to be more dominant than the organisational solutions provided. Such organisational constraints included the lack of training, lack of time, lack of additional finance and resources, insufficient hardware and software, and inappropriate school timetabling. These were very similar to the research findings of Elder et al,1982 (time and timetabling); the ITMA team, Phillips et al, 1983; Ridgway et al, 1983; Fraser et al, 1983 (training, software and hardware); Pengov, 1977 (adequate computer resources prior to adoption); Sledge, 1981 (the provision of adequate and appropriate software); and Wayth, 1981 (hardware). Inspite of these organisational constraints, the support provided by the Headteacher produced a large force which led to a gradual uptake of computers in the school over the one and a half year period. This uptake of computers was however mainly in the area of administration and not in teaching.

Additional forces, but this time at the educational system level, started to appear especially as teachers began to use computers in their teaching. For example, teachers were concerned with the issue of the curriculum, that is, the appropriate integration of computers into the curriculum, and the limiting nature of the examination syllabus which might have a dampening effect, or might even be a limiting factor, in the uptake of computers in the school. These forces could possibly become more acute if the use of computers in teaching were to increase. The research studies conducted by Elder et al (1982), Jones and O'Shea (1982) and Sheingold et al (1983) also hinted at this problem.

5.0 SUMMARY

It could thus be seen that the actual uptake of computers is very much dependent on the interplay of various factors at different levels. It became apparent that the views and opinions held by teachers

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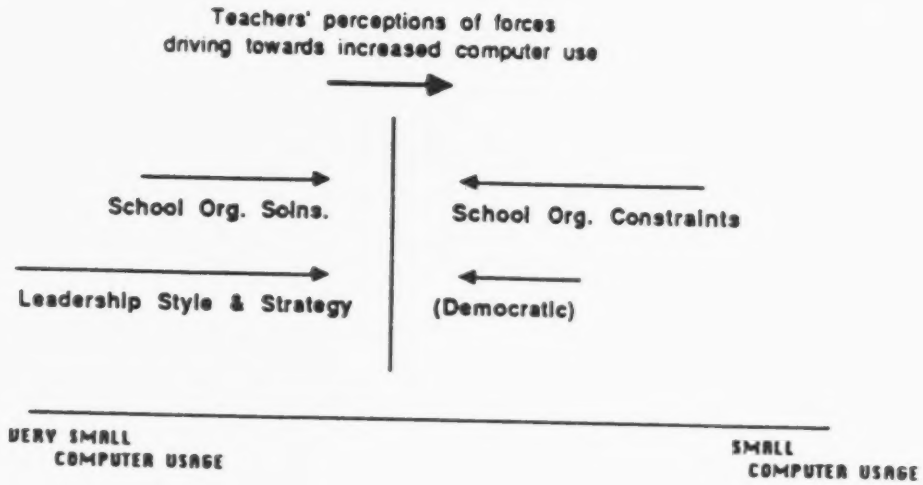

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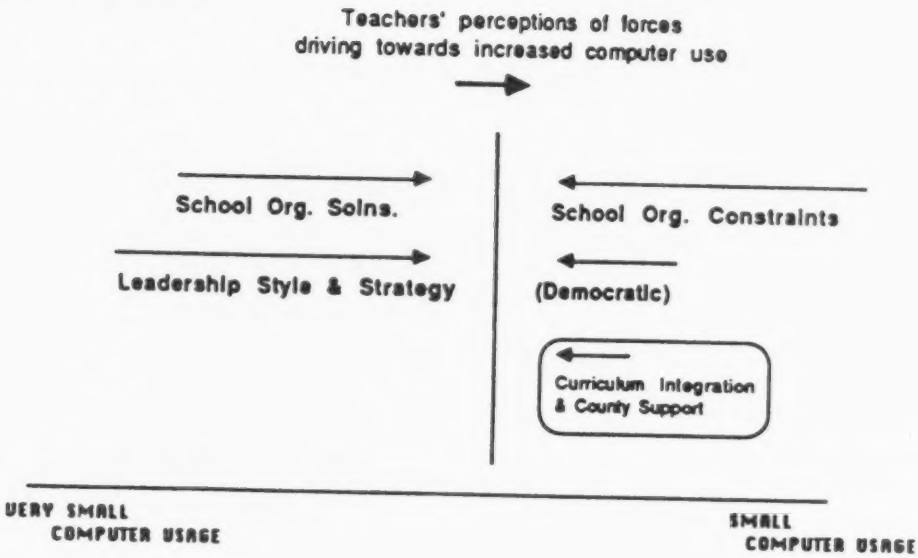

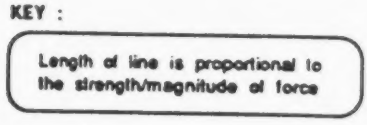

Figure 18 **Force Field diagrams for Barnaby Comprehensive over the one and a half year interval.**

about computers were not just black or white, but revealed an extremely broad spectrum of views, even within just five departments of a school. These views ranged from the very positive (the Favourable), to the positive with reservations (the Critical and the Worried), to the neutral range (the Indifferent and the Uninitiated), to the negative (the Unfavourable) and finally, to the very negative (the Antagonistic). Teachers perceived that the use of computers in teaching would result in changes in themselves as an authority (i.e. being competent), changes in themselves being in authority (i.e. being confident), and changes in their teaching situation (for example, class size). The use of computers was perceived by teachers to be a new and powerful technology that required specialist knowledge which could only be obtained through extensive learning and training. More worrying however, was that some of the teachers perceived that they themselves, by their very nature or abilities, would not be able to acquire this new expertise as they saw themselves as not "logical or mathematical" with some even seeing themselves as being too "old" or "set in their ways" for this new educational technology.

Organisational constraints were seen by teachers as barriers, which many of them felt could not be solved individually, but which needed cooperation from staff "above" them. Some of the main organisational constraints perceived by teachers included that of insufficient time, lack of finance and resources, and the limitation of having big class sizes. Time emerged to be a major organisational constraint with far reaching effects. Although time was initially seen as just providing the opportunity for training and using computers (including time for evaluating and testing suitable software), what emerged from the research study was that providing sufficient time for teachers was crucial for them to feel and be competent and confident in using computers. The other major organisational constraint was a perceived lack of finance and resources to adequately sustain the computer implementation within the departments and school. This perceived lack of resources became more acute through the passage of time and as their awareness of the use of computers and the limitations of the computers that they had purchased grew.

When it came to actually using computers, the organisational leadership of the department heads seemed to play an important role. Favourable attitudes by heads of departments and appropriate leadership strategies that formulated policies which provided resources were essential before any

take-up of computers could be achieved. It seemed that teachers initially needed strong guidance (even to the point of being shown exactly what to do) before they would venture to use computers in their teaching. This could be provided either voluntarily by the head of department (as was the case in the Geography department with a lassiez-faire leadership style) or with a little "forced" persuasion (as was the risk taken by the head of the History department with an autocratic leadership style). In a lassiez-faire environment, the responsibility for innovation (and for the associated learning and acquiring of skills) is left to individual teachers to take personal initiative. The Mathematics department however showed that the concern teachers had about how they felt they should be seen by society, seemed to be an overriding factor which led to a slight increase of computer usage. It could be hypothesised that the mathematics teachers became aware that they needed to be seen by society as being knowledgeable in the use of computers, i.e. they became concerned about their self-image. Thus, it seemed difficult to identify a particular factor that was determining the uptake of computers in a department of the school. Just as there were different departments, there were also different combinations of factors (of attitudes and leadership styles) under different situations that led to any real use of computers in the departments.

Finally, whether there would be a continual increase in the use of computers could also be seen as being dependent on local education and national policies. At the local education authority level, this has to do with the provision of adequate technical and financial resources and the provision of expertise, among other things. At the national level, this has to do with a thorough rethinking of the curriculum, of how the use of computers could be integrated within various subjects. It involved the learning and use of different computer skills with an examination syllabus that reflected such priorities.

6.0 IMPLICATIONS OF THE RESEARCH STUDY

If the use of computers is to be successfully introduced into schools, then consideration should be made at the different levels of the teacher, the organisation of the department and school, and the influences outside school. Within each level, considerations of in-service training, support systems, management styles etc. could be examined.

6.1 At the Teacher Level

There are a range of possible approaches to cope with the variety of teacher attitudes about computers. It is important that the strategy and content of any in-service training (INSET) should consider the various attitudes that teachers have about computers (as provided by the categories in this study). It is recognised, however, that there is the problem of diagnosis, i.e. of being able to identify these different categories of teachers, and the problem of formulating specific in-service training courses that would be suitable for each category of teacher. There could be the possibility, for example, of considering the intake of INSET in terms of specifying experience, attitudes and level of computer knowledge. Although this would not get rid of all of the problems of inappropriate training, it might be a first step towards it.

INSET courses should be organised with a different emphasis for the various groups of teachers. Alternatively, if separate courses can not be organised for the different categories of teachers, then it might be beneficial to allocate a portion of the time of INSET for small group work where teachers could be divided according to these categories. Hence, for these different categories of teachers with different attitudes, possible strategies of INSET courses (and hence content, approach taken and focus) that could be formulated would include :

1. For the Worried - The emphasis of the INSET courses for this category of teachers could be to build confidence in teachers by providing them with adequate training to acquire the skills for using computers effectively in the classroom. This is to enable teachers to perceive themselves as being competent and in control of the class situation. It might be worthwhile to stress the fact that computers

provide a tool for teachers to enhance their teaching repertoire. Finally, different teachers with different self-concepts and from a wide range of subject backgrounds, could be encouraged to attend such courses, stressing the fact that it is not only for the scientifically, mathematically or logically orientated teachers.

2. For the Critical - INSET courses could be more open-ended for this group of teachers. The courses should be geared to handle the specific criticisms that teachers might have with regards to the use of computers. The different ways in which computers could be used in teaching could also be explored, with computers being used both with small and large groups as well as pupils from the two extreme ability ranges.

3. For the Favourable - INSET courses could be a time where teachers are able to share experiences of how they use computers in their teaching. The exchange of ideas and software (including training in the evaluation and testing of educational software) would be very beneficial to everyone at this stage. Some time could even be used to explore and develop new ideas and techniques in using computers in the classroom, and for those teachers who write their own personal software, hints and tips for doing so could be exchanged.

4. For the Uninitiated - The emphasis of the training could primarily be to promote a basic awareness and understanding of the use of computers in general, in teaching and in administration. The content of the course should therefore include demonstrations of the different ways of using computers and the impact and effect that computers would have personally, in society, and in their profession.

6.2 Department and School Management

6.2.1 Leadership Styles

Leadership styles of the heads of department and Headteacher played a very supportive role in the introduction of computers in schools. Thus, in the area of department and school management :

1. Very strong leadership, in terms of providing a clear, coherent and immediate computer policy for the department seemed to be critical at the early stages of an introduction. This strong lead is essential if teachers are to be encouraged to make the extra effort and time required in acquiring a new skill and expertise. In the long term, this leadership style could be a more democratic form of leadership so that any initial hostilities that might have arisen as a result of too strong a leadership role would give way to a greater sense of cooperation and work towards the common goal of using computers in the classroom.

2. Support from Headteachers is crucial. Teachers realised that any form of innovation was heavily dependent on the support and enthusiasm of their Headteacher. They felt that direction must be given by the Headteacher, but this direction must be backed up by adequate resources. They were however concerned that Headteachers should not just go ahead with introducing computers in schools as a "public-relations" exercise aimed to provide a better image for the school.

3. Overall school policy. In the long term, there could be an overall school policy with individual departments fitting into that plan. A definite and on-going policy by heads of department and Headteachers on the use of computers and the provision thereof, in terms of adequate department capitation, are essential to sustain a constant growth in the use of computers in the school.

6.2.2 In-Service Training (INSET) Programmes

Heads of departments and Headteachers play a crucial role in the nomination and selection of teachers to be trained in the use of computers. Most teachers do not have a direct say in this as the criteria for selection is normally left to the Headteacher and is chiefly limited by the amount of funds available for training, both in the school and in the local education authority. It might be advantageous in the long run for heads of departments and Headteachers to send teachers for INSET courses on the basis that:

1. They are those who would be given the responsibility to initiate some form of training for their colleagues, that is, to provide INSET within the department and school, and to implement the use of computers within the department and school.

2. They are those who would be given sufficient resources to provide help to their colleagues in using computers.

3. They represent a wide subject range of teachers, not just Mathematics or Science teachers.

6.2.3 Internal Support System

If schools regard it as important to be using computers, then it might be beneficial in the long term for teachers to perceive that their school is giving this priority in terms of finance, time and personnel resources being allocated. These can be shown in the following ways :

1. Providing Financial Support. Additional and sufficient resources could be provided by the heads of department and Headteachers, and could include not only the computers but the necessary peripherals, software and stationary that goes with using computers. It would be helpful if the departments' capitations could be budgeted so that all relevant purchases of hardware and software are taken into account. Preferably, finance to purchase full computer systems should be provided at the very onset so that teachers could immediately use the computers in their teaching and not wait for other hardware or software to be purchased in the next financial year. Finance could also be provided for the provision of adequate facilities, for example, room(s) to safely house the computers, with suitable power supplies, or computer trolleys to transport the entire system which would include a large monitor, to different classrooms.

2. Providing People Support. Heads of departments and Headteachers could identify and appoint teachers who would be available and would be given the resources to help their colleagues in using computers in their teaching within the departments and school. It could also be advantageous in the long term if they could appoint teachers with the sole responsibility of encouraging the use of computers across the curriculum.

3. Providing Technical Support. Just as there is technical support provided for audio-visual equipment, there should also be technical help provided by the school for the use of computers. Technical expertise should be provided to handle minor repair work, fixing or making of new cable leads, monitors etc. These, teachers felt, should not be done by other teachers, but instead should be carried out by appropriately trained technicians.

4. Providing a Booking System. A booking system, similar to that of the audio-visual equipment, should be instigated whereby computer resources and facilities could be centralised (either within a department or within a school) and hence more efficiently shared by teachers.

6.2.4 School Timetabling

While having appropriate training courses and providing sufficient finance and resources go a long way in encouraging teachers to use computers, the continual demands on teachers' time imposed by the syllabus, school activities, etc. make it all the more essential that, if the use of computers is seen to be important, some form of priority be given to provide teachers with additional time for :

1. Personal Training. Teachers are under continual tensions and pressures to discharge their responsibilities as teachers. It could be helpful if teachers were provided with the time to know and acquire the skills necessary to use computers quite apart from the time needed to plan the lessons with the computers and pupils in mind. In addition, it could be profitable if extra time were provided for teachers to explore and experiment with the different uses of computers and to see whether any of the available software would be suitable for their teaching.

2. Department/School Training. It could be advantageous if training in the use of computers were conducted within the school and during the schools' allocated INSET programme. In Barnaby Comprehensive this included part of school hours when pupils would return home early for the day. This would enable teachers with other school responsibilities to attend these computer training sessions. It may be possible for more time to be given to the training of teachers in the latter part of the

summer term, when most of the public examinations have been completed and when the teaching workload is comparatively less.

In addition, slots within the school's INSET programme could be earmarked for the training of different groups of teachers (according to the proposed categories of teachers as mentioned earlier), and not just according to department groupings in the use of computers in teaching. Preferably, according to teachers in Barnaby Comprehensive, these training sessions should be conducted by other colleagues in the school. This training could also include actual "hands-on" experience and demonstrations of the different ways of using computers, both in administration and across the curriculum.

3. Advice and help. Time could be given, and preferably timetabled, for those teachers who would be helping and advising their colleagues in using computers. These teachers should not be expected to put in too much of their own personal time, especially when it is the entire school that will benefit from their endeavours.

In addition, the school timetable could provide opportunities for :

4. Involvement from a wider pupil range. Opportunities could be provided for all pupils to be able to use the computers, and not just the pupils in the extreme ability ranges. Specific time could be allocated to allow different groups of pupils to use the computers in the school.

6.3 At the Education System Level

Although the research study did not look specifically at the education system level, teachers mentioned factors that influenced their opinions about and actual use of computers. What is provided here are suggestions of research implications as a result of some comments made by teachers. It is realised, however, that the British educational system is already under financial strain, and any financial, technical or training support given to encourage the use of computers in schools would mean a reduction in support for other curriculum areas.

6.3.1 County (LEA) Support

As was the case with support from heads of departments and headteacher, teachers also felt that efficient and immediate County or Local Education Authority support is crucial for the school that attempts to introduce the use of computers.The is especially in terms of :

1. Financial Support. There was a lack of understanding among teachers as to whose responsibility it was to provide adequate finance for introducing computers into schools. According to some of the teachers, adequate finances and back-up could be provided by the County (and not by Parents Associations) before the County encourages schools to embark on such an implementation. Finance could be provided not only for the computers systems and related hardware and software configurations, but also for the training of teachers and for providing relevant expertise to schools.

2. Technical Support. The quick and efficient technical support by County (for example, in the memory upgrading of computers) would be vital to sustain the growth and use of computers in schools. It would be beneficial if County could coordinate with the national authorities (especially the DES and the DTI) to quickly decide on the computer hardware that it will support in schools.

3. Dissemination of software and software information. LEAs could link in with central software organisations so that constant and up-to-date information could be made available to schools. This is especially important in the area of software and hardware reviews, and in the exchange of ideas and feedback between teachers and software houses.

4. Training for decision-makers. It could be advantageous for LEAs to provide a separate training programme for heads of departments and Headteachers. The content of such training could include aspects that have been discussed above, but the point being made is that it is vital that the managers in schools should be trained to be more aware of the dynamics involved in the introduction of computers within their departments and schools, that is, the social relationships, organisational and managerial considerations involved in any implementation.

5. Length of INSET courses. Teachers felt that any INSET programmes should be more than just a few hours of a day stretching perhaps, to at least three full days, so that adequate ground could be covered.

6.3.2 Curriculum Planning

1. Planning across the Curriculum. There seemed to be a need to coordinate the use of computers in the various subjects. This is to ensure that different types of CAL are being employed by teachers and that different skills are being acquired by both teachers and pupils across the curriculum as a result of using computers. The problem would be to ensure that the same computer skills being taught in different subjects would not be excessively duplicated at the expense of other computer skills being neglected. For example, the use of databases by both the History and Geography departments and wordproccessing by the English and Business Studies departments should not be covered at the expense of forsaking the use of simulations or modelling in other subjects. In addition, pupils should be safeguarded so that they would not have an unnecessarily excessive exposure to computers.

2. Examination syllabus. Teachers are concerned that the present examination syllabus did not positively encourage them to use computers in their teaching. If the use of computers is important for both teachers and pupils, then teachers feel strongly that this could be reflected in an appropriate way in the syllabus.

6.3.3 Software Development

1. Any software which is being developed and written, could be such that :

a. It would provide immediate personal benefit. This is especially so for software used for administration. Any software written that would save time for teachers in school administration and not involve too much learning on the part of the teachers, could be immediately popular.

b. It is very "user-friendly" and robust. It is important for teachers to be able to use software quickly and easily, and to use software which allows them to make mistakes without the program "crashing". This is especially crucial as teachers would not use any software which could make them appear incompetent in front of their pupils.

2. Writing and vetting educational software. Teachers were aware that it was inadvisable for them to be writing software. They felt, however, that software development teams which included teachers, computer specialists, representatives from examination boards, universities and colleges were important. They also felt that these groups could provide the necessary guidelines and evaluation reports of vetted software (similar to examination syllabus) which could be easily referred to by teachers when considering the purchase of specific types of software.

3. Software information networks. Teachers realised that the communication and information systems whereby they could be informed of the latest software and how best it could be used in the different teaching situations, needed to be examined. Teachers suggested that schools could be electronically linked with national networks (like Micronet) where such information could be easily accessible to any teacher as opposed to the department heads receiving catalogues from publishers via the traditional channels. In addition, software could be provided in Teacher Centres, where teachers could preview and evaluate software, and software information could be provided in subject-related periodicals or teacher magazines, and not just computer magazines.

6.3.4 National Programmes

It is worth noting that no mention was made by teachers (with the exception of one) of the government's national efforts to encourage the use of computers in schools. The exception was by a head of department who only referred to the Department of Trade and Industry's (DTI's) subsidy scheme of providing 50% discount to a school purchasing a computer (one per school). He saw this scheme as a "whitewash" idea which would be unfair to larger schools. Two other teachers mentioned that they had attended an INSET course, but did not associate it with the fact that they were required to attend as a result of the school purchasing a BBC computer under the DTI scheme.

There appears to be a need for more effective communication between national initiators of computer innovation and "grassroot" users. Teachers in Barnaby Comprehensive were unaware of any of the training courses that were being organised (for example, courses organised under the auspices of the Microelectronics Development Programme) or the teacher-groups that were set up to develop new and appropriate educational software. More rigorous publicity and information channels could be set up to filter any information at the national level to the individual teachers in schools. The assumption that information sent to a school via the Headteacher or even the heads of department will reach the individual teacher, should not be made.

7.0 RESEARCH LIMITATIONS AND FURTHER RESEARCH

One of the main limitations of this research study, as a result of finite time and energies, is that the investigation carried out in the school was restricted to only a small sample of teachers and heads of department in a school. No observations were carried out in the classrooms or with pupils, and other teachers and departments were excluded from the research study. Thus, an immediate area of further research would be to increase the breadth, depth and time of this research study. This could be done by separate research studies looking at each aspect in turn, or by a major study. For example, it would be useful to look at the rest of the teachers within the five departments and to look at the other teachers in the other departments who have started using computers in the school. This would be important to clarify the findings already highlighted in the present research or even to "throw-up" further combinations of factors that would influence the uptake of computers in the school. Another immediate area for further research work would be to analyse the views and opinions of pupils towards computers and the use of computers in their lessons. In addition, it would be important to examine the processes of learning and interaction that pupils have between their peers, with their teachers, and with the computers as a result of the use of computers in the classroom. This is a work started by the ITMA Collaboration. It would also be crucial to pursue the research to the point where computers are used in various sorts of ways, in different classrooms, and with pupils of different abilities and backgrounds. This research could also be conducted for a longer period of time (i.e. a longitudinal study) as any real uptake of computers would require a much longer timescale. Attitudes, leadership

styles and strategies might change through the passage of time, which would lead to a different picture of computer innovation in Barnaby Comprehensive.

In addition, other similar case-studies could be conducted in other schools, so as to provide different approaches to our understanding of the implementation of computers in schools. It would be interesting to find out whether the different categories of teachers and leadership styles of heads of departments are also prevalent in other schools, and if so, what sort of schools. Are the interplay of factors at the different levels similar to that of Barnaby Comprehensive, or would there be other combinations of factors interacting ?

Just as departments are socially organised within a school, so too are schools organised within the social structure of Local Education Authorities (LEAs), and these in-turn are organised within the educational systems and political structure of a country. Schools are affected by external influences which would encourage or hinder the use of computers in schools. It is thus vital to look at these other levels of an innovation. For example, it would be important to understand the roles that LEA advisors might have in the introduction of computers into a school, or to understand the extent that financial policies of LEAs would determine the uptake of computers in schools. This analysis could then be extended to the national level to look at, for example, the roles of HMIs or the effects that national policies have on schools. Lundgren's Frame Factor Theory, White and Lippitt's categories of leadership styles, and Lewin's force-field representations, for example, provide suitable models and tools to examine such innovations at these various levels, with a visual and dynamic display of the forces at work.

However, even with this single research study which was based on fifteen teachers within five departments in a school, there can be further areas of research work to be done as a natural follow-up. This could be in the following areas :

1. Teachers seemed to be more concerned about the damage that would be done to computers by pupils, than the damage that computers might cause to pupils either physically or educationally. Do teachers see "class control" with respect to the use of computers, as a reflection of their competence

as professional teachers ? For example, if computers were damaged by pupils during a lesson, would teachers perceive that this would be a poor reflection on their reputation as a "good" teacher ? This research seemed to indicate that teachers were concerned about how they were seen to be in control of the situation. More work needs to be done to identify the elements of a class environment that lead to such perceptions by teachers, or to check whether these perceptions, for example, are an indication of deeper worries or tensions which are related to how they perceive themselves and their teaching profession.

2. Teachers seemed to have the impression that the use of computers was only for the brightest pupils or for the low-ability pupils. What are the dangers of computers becoming either an elitist toy (for the brightest pupils) or a compensatory aid (for the low-ability pupils), such that the pupils who are in-between the ability range are left out ? Can there be different but appropriate ways of using computers for each of these groups of pupils ?

Another related problem seems to be that if pupils from the two extreme ability ranges were to use computers, would pupils themselves label each other as "dull" or "bright" if they were requested by their teachers to use the computer ? On the other hand, there seemed to be the idea that teachers think that using computers gives the impression that they are "progressive" and professional ? If this is true, there is thus the problem that if a teacher uses computers, he/she is considered "progressive", while his/her students is labelled as "dull" or "bright". Research needs to be done to find out whether this is a prevalent feeling amongst pupils and teachers, and if this is so, can different approaches be used in teaching with computers so that this problem is avoided ? How does one get away from labelling either pupils or teachers when using computers ?

3. The use of computers can be seen to involve new and different ways of teaching, with a corresponding change of roles (an area that was also initially explored by the ITMA Collaboration). Further research needs to be done to investigate, for example, these new forms of teaching and its effects on class discipline or the organisation of the class. Would there be extra tensions, as well as new areas of challenge, developing as a result of this new and powerful educational technology ?

Related to this is the question of whether Computer Studies as a separate subject should be disbanded, and replaced with an emphasis of using computers across the curriculum. If so, how can computers be effectively used across the curriculum ?

4. Finally, this research had shown that leadership styles within departments play a role in the uptake of computers by teachers. It would be helpful to explore, in greater detail, the sorts of management styles that are prevalent within departments in other schools, and to see how these styles actively encourage or discourage the use of computers. This would provide further and essential input to any INSET courses organised for the local management in schools.

There is a need for further research to investigate the necessary ingredients for an effective in-service training programme that could be conducted within the school itself. As this research study has shown, one of the key ways of promoting a real uptake of computers in the school would be to conduct regular in-service training programmes not only for individual teachers but also for heads of departments and headteachers. Research needs to be done to find out what should be included in INSET courses for teachers, and separately for policy or decision-makers in the school. Furthermore, would teachers from schools be the best people to conduct these courses or would "professional" or even commercial agencies be the best people to be contracted to conduct such courses ? Would INSET courses be most effectively conducted in schools or should it be conducted in Teacher Centres or even Universities and Polytechnics ? Although this research has suggested that INSET courses within the school itself is essential, more work needs to be done to discover how this can be effectively and efficiently carried out.

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DEDICATION

To Mum & Dad

for all your love and understanding

and

for bringing me up in the fear of the Lord.

2 Timothy 3:15

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* Barnaby comes from the word "Barnabus" which means "Son of Encouragement".